NEXT MONTH

For five or six years prior to the national emergency the lion's share of the new process industry plants erected in the United States were located below the Mason & Dixon Line. But what effect has the emergency had upon the decentralization program that caused so many companies to turn their attention to the South? Has this movement been arrested and if so is it likely to be temporary or permanent? And what share of the national defense plants is the South receiving? *Chem. & Met.'s* managing editor, James A. Lee, has just completed a first hand investigation of the situation in the southern states and will report his observations in July.

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CHEMICAL & METALLURGICAL ENGINEERING

ESTABLISHED 1902

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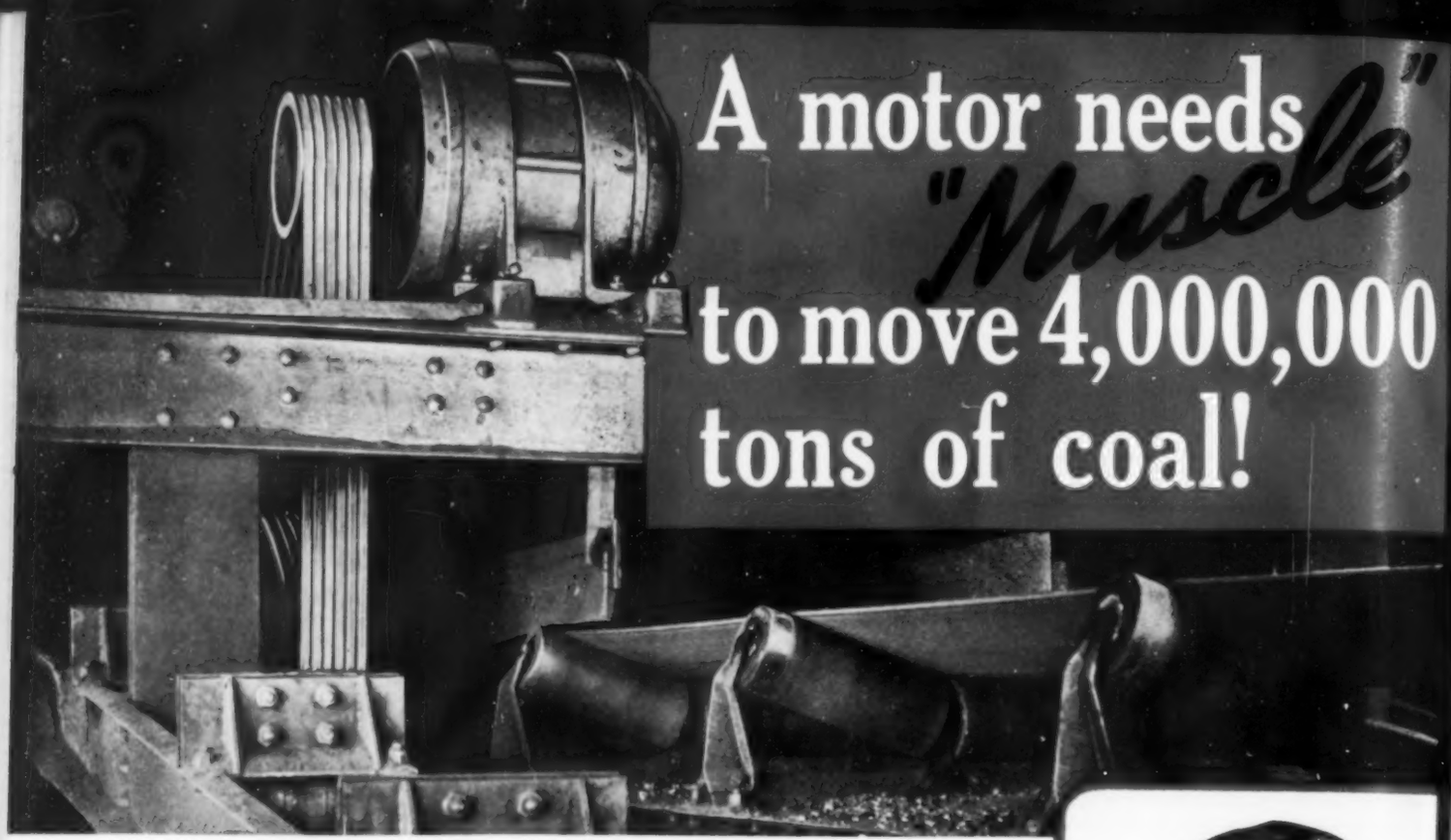

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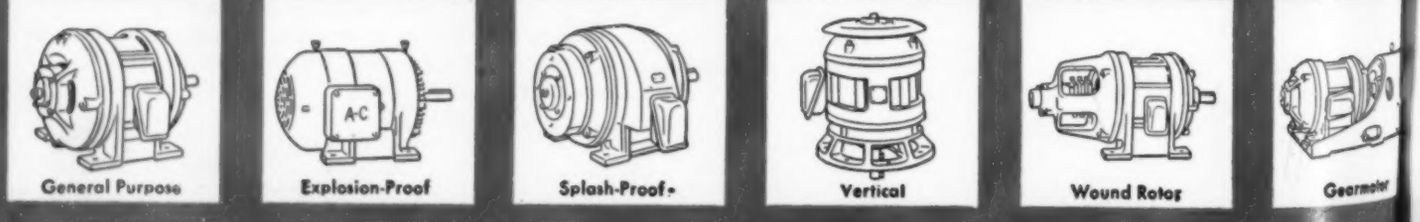


ALLIS-CHALMERS LO-MAINTENANCE MOTOR

CHEMICAL & METALLURGICAL ENGINEERING

ESTABLISHED 1902

S. D. KIRKPATRICK, *Editor*

JUNE, 1941

WHY THESE CHEMICAL SHORTAGES?

ISN'T there enough of anything? Are supplies of almost everything that has any military significance —and many things that haven't—becoming entirely inadequate? Why all these shortages? Whether justified or not, these are questions that are constantly being asked of American chemical manufacturers.

The plastics people can't quite understand why formaldehyde, phenol, cresol, or phthalic anhydride should suddenly become "tight." The papermaker who last year had four companies fighting for his chlorine business is worried sick about the way they now scorn his patronage. Aluminum and magnesium are rare, if not precious, metals. Ammonia, potash, permanganate, acetic acid, borax, mercurials and zinc salts are all being rationed to civilian customers. Why?

Undoubtedly the first reason for chemical shortages—real or prospective—is the direct and indirect effect of government buying. Actual purchases for military uses may not have yet been very large, but the constant upward revision of requirements for the defense job is putting question-marks behind every production schedule. The second reason, and perhaps of the most immediate importance, is that most of the chemical consuming industries are now operating at practically full capacity. Large numbers of people, newly employed at higher wages, are spending their money for long deferred wants. As a result, the whole consumer goods field is booming. A third cause of some shortages lies in sudden shifts in consumption that make today's plenty tomorrow's scarcity. Plastics are a case in point with their chain of new shortages. And, finally, although there are no specific data to prove it, some of the men in OPM are convinced that considerable "stockpiling" is going on in American industry today. They believe that two kinds of "fudging" are being practiced: buying in excess of needs and buying sooner than needs arise.

In our opinion many of these problems, particularly in the chemical industries, should not be the cause for serious concern. There is enough inherent flexibility and resourcefulness to take care of all except the most unreasonable demands. However, it is becoming apparent that not all chemical manufacturers are adequately aware of these growing needs or sufficiently aroused to meet them promptly. A radical change in the philosophy of management in these plants is becoming more and more necessary. Those that have been content to work a five-shift or six-shift week, must soon go to ten shifts or twelve shifts, or possibly even to twenty-one shifts. Seasonal peaks will have to be leveled out so that fewer people working more days in the year can turn out the required quantities of goods. It is particularly necessary where there are real or threatened shortages of skilled workers.

Another way in which our industries can and must help, is in more willingness to share in the defense load. Many plants not now working for the government must find assignments for themselves either as direct suppliers or as sub-contractors. Especially is this true where there are idle or partly idle shops with machine tools that can be employed in repair work or in building equipment for defense industries. These shops and their skilled mechanics can find plenty to do for full-time employment.

Obviously, there is a big job to be done by the chemical industries, *right now*. Idle plant capacity and idle men can no longer be tolerated in industries that are so vital to the national defense. The best answer to chemical shortages is the immediate production and delivery of more and more goods—at the same time making adequate provision for even more when the time comes.

FROM AN

BETTER BE READY

THUS FAR very few chemicals are so restricted in distribution as to require official priorities. But there will be many changes in the normal relationship of supply and demand under the greatly accelerated activity of industry. It will be too late to do your planning for substitute methods or substitute materials or makeshift manufacturing equipment when the priorities have been fixed. The time for planning is now, if it is not already too late. In this planning there are a number of broad principles to be considered. Take these few for example and then develop a few more applicable to your own position or enterprise.

All metals are already subject to informal or formal priority control. To secure new parts or new machinery, even for repair and replacement, is going to be increasingly difficult.

Chemicals used in any direct defense activity, like ammonia, are already under official restriction and may be affected by priority rules in the very near future. Transportation is becoming difficult as much water-borne traffic is transferred to the rails and the increase of industrial business loads the freight cars with unprecedented total tonnages. The locomotive shortage is an even more serious prospect.

All this means that each chemical engineering executive must know where his raw materials, his equipment, his maintenance and repair parts and supplies and his other purchases are going to come from. He must figure out just what he would do if the emergency arises that he cannot get any of his normal supply. Planning for extreme inconvenience or emergency will make those expectable difficulties less embarrassing. It cannot be over-emphasized that the planning for substitutes either substitute chemicals, substitute equipment, substitute processing methods, or even substitute personnel must be considered necessary *now*.

PAINFUL SHORTAGE OF SHIPS

SHORTLY the government will probably appoint a board of transport priority. The purpose of that agency, representing Army, Navy, OPM and other government groups, will be to allocate the available cargo space for use of the most urgently needed commodities. Thus, for example, tin, rubber, copra, antimony, tungsten and the other supplies from the Far East will be arranged in the order of precedence which seems expedient from time to time.

This means a very important new factor must be faced by certain process industries. For example, the soap man may have to consider quite soon what he is going to do when he cannot get his customary proportion of coconut oil. He may be confronted with the problem of using synthetic fatty acids as a partial substitute. And that's only one of a hundred modifications of process or shifts in raw material that may become necessary within the next few months.

Every industrial executive who even indirectly depends upon imported materials must promptly face this situation. It is none too soon to figure out what can be done in each plant if foreign shipping is cut off for any commodity of local interest. If we assume the worst now, we will be better ready for what may actually happen.

PERSONNEL POLICIES GROW

FORTUNATELY, the importance of the chemical process industries to the national well-being is highly appreciated in Washington. The Selective Service headquarters has come as near to blanket exemptions for skilled artisans and professional workers in the chemical engineering field as is permitted by the law. General requests have gone out to all local boards to avoid depleting an important industry merely to send a few more boys to the nearest cantonment.

Industry executives have a supplemental responsibility. In the first place they must not be too short-sighted in their patriotism. They must not decline to ask for deferment for those men who are difficult to replace. Furthermore, they must not fail to take advantage of the new permanent exemption for those persons who are practically

EDITORIAL VIEWPOINT

irreplaceable in their present duties. The fact that the government has said to local boards that certain men are to be deferred indefinitely, not merely for six months, is evidence that Washington wants action along these lines.

Chem. & Met. has repeatedly emphasized the need for developing a reserve personnel ready to step up to greater responsibilities. The importance of this up-grading of junior workers and the training of specialists beyond any immediate prospect of need cannot be over-emphasized. We are not entering into a period of unlimited emergency that is likely to be short or easy. Exigencies of every kind may be anticipated. An over-trained, over-skilled personnel is almost unthinkable.

Further educational effort either in the plant or by vocational school cooperation or in cooperation with the engineering colleges is essential. Those who have not yet put in their E.D.T. or other courses had better take this matter up right away with the U. S. Office of Education. Or if it is more artisans that are needed, the training section of OPM will be ready to help. Read again our January report on "Chemical Man-Power for National Defense."

A DECLARATION OF PEACE

A RECENT address by President Wheeler McMillen, of National Farm Chemurgic Council, sounds to us like the declaration of peace between the chemurgists and the petroleum industry. Mr. McMillen, discussing the use of alcohol as a motor fuel with gasoline, quotes a Department of Agriculture sentence and then concludes: "In the light of this situation, it is apparent that it would be destructive to the best interests of farmers to undertake to establish by compulsion, or to encourage by preferential tax treatment or other legislative subvention, the use of a product which no process yet developed will produce at a reasonable cost and which could not now possibly permit reasonable returns to farmers."

We hope that we are right in interpreting this as a gesture of peace between those groups who have a mutual interest, but have not always acted as if they had. When it becomes economically sound to put alcohol in as a part of the motor fuel of this nation, there is no group that has more interest in doing so than the petroleum refiners themselves. In order to exist permanently on a profitable basis, they must serve their ultimate customers, the motorists, with the best available fuel, all factors considered. At such time as alcohol becomes a desirable component of such fuel they must, even in their own selfish interest, add it.

Likewise, those who ardently work for more extensive use of agricultural materials in industry can hope for success only on a sound economic basis. They will hurt their own cause, not help it, by prematurely pressing methods, products, or activities which do not find real basis in technical and economic fact.

In the past, some over-ardent spokesmen of both sides have been harsh in their comment on the motor fuel situation. We feel certain that Mr. McMillen's comment will now be welcomed by both sides as a basis for real cooperation.

WE APOLOGIZE

LAST MONTH an innocent little news item entitled "Federal Grants for Chemical Engineering Courses" brought us so many letters and phone calls that we had to mimeograph and syndicate our replies. It referred to Senate Bill 1380 introduced by Senator Reynolds on April 25, 1941, which was read twice and referred to the Senate Committee on Education and Labor. It provides:

> "That the Federal Security Administrator, acting through the Office of Education, is authorized to make grants of funds to any college in which chemical engineering is taught for the purpose of enabling such college to expand its facilities, and acquire necessary equipment for the teaching of chemical engineering. The aggregate amount of such grants to any one college shall not be more than $1,000,000."

That much we reported accurately; but it seems that we erred seriously in saying that this legislation was "practically certain to pass." Our second guess is quite the contrary. What seemed to smell to many of our friends like a savory piece of pie from Uncle Sam's free lunch counter turns out to be a lemon. But isn't it interesting to see how somebody thought this would be a swell way to get a well-equipped chemical engineering building and laboratory?

Refining Operations in New Mexico's Newest

A. H. HUBBELL *Associate Editor, Engineering and Mining Journal*

Chem. & Met. INTERPRETATION

Unique processes and equipment have been successfully applied in both the mining and refining of potash salts by the Union Potash & Chemical Co. of Carlsbad, N. Mex. Latest to enter this industry, the new enterprise was first in this country to produce potassium sulphate commercially from langbeinite ore. (See *Chem. & Met.*, Jan. 1941, p. 77). Union is a subsidiary of International Agricultural Corp. and the further development of a process by the technical staff of International for the utilization of the magnesium chloride in the waste liquor of the sulphate plant promises another timely contribution to the national defense program. For a remarkably complete account of all phases of the Union Potash enterprise, *Chem. & Met.* readers are referred to the excellent series of illustrated articles by Mr. Hubbell which were published in the April 1941 issue of our sister publication, *Engineering and Mining Journal*, Vol. 142, No. 4, pp. 43-71. The following description of the operations of the new potash refinery is largely abstracted from Mr. Hubbell's articles, supplemented with a few personal observations and photographs taken by the editor of *Chem. & Met.* during his visit to the mine and refinery in December 1940—*Editors.*

THE NEW ENTERPRISE of the Union Potash & Chemical Co. comes on the scene at a critical time when, with foreign supplies of potash again cut off, it can aid materially in meeting this country's requirements for this most essential mineral. Reference has already been made in *Chem. & Met.* (Jan. 1941 p. 77) and more extensively in *Engineering and Mining Journal* (April 1941 pp. 43–71) to the achievement of the mining and engineering staffs of the International Agricultural Corp. which holds a controlling interest in this newest entry into the potash industry. The remarkably rapid development of the mine to the point of successful production and the provision of adequate plant facilities and processes for efficiently refining and treating its ores, sets up some new records for both the mineral and chemical industry. Moreover the current research program by the International staff is pointing toward other important developments, particularly in connection with the possible utilization of a magnesium chloride byproduct as a source of metallic magnesium for the pressing requirements of National Defense.

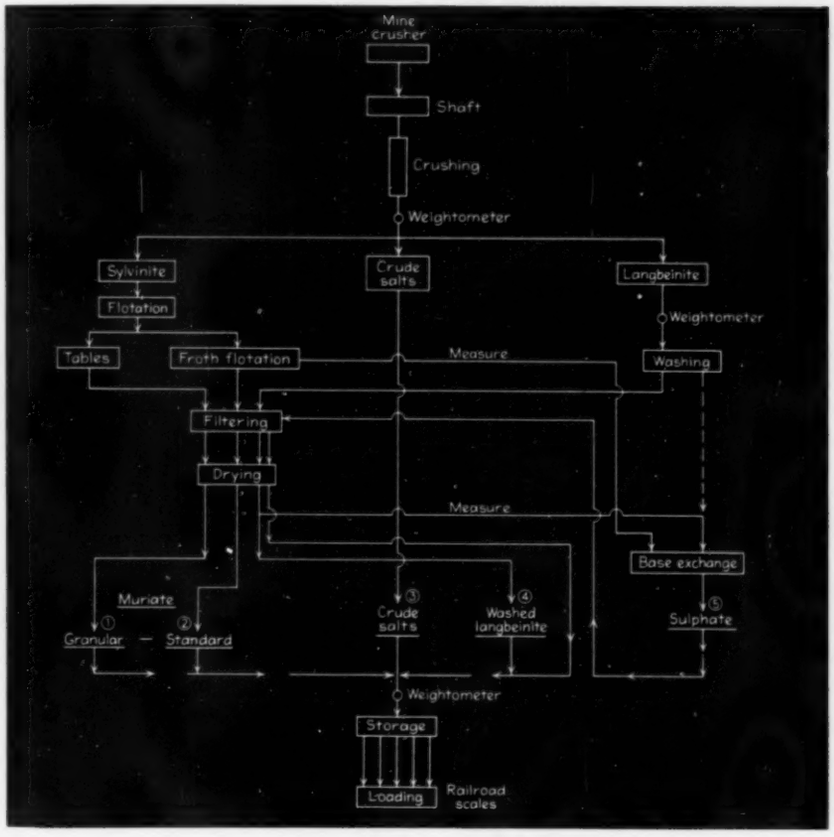
The crude potash ores, containing potassium chloride and the double sulphate of potassium and magnesium (langbeinite) are refined and prepared for the market in a new plant that stands immediately adjacent to No. 1 shaft at the mine. Although some crude salts are stocked temporarily on the ground nearby, this plant is normally handling the current output of the mine, which is somewhat more than 2,100 tons of sylvinite and langbeinite ores combined per day. These ores are hoisted separately, because they are mined at different levels, and are treated separately throughout the process, although, as will be pointed out later, portions of the two are combined after treatment to produce an additional final product, potassium sulphate.

At present the final products of the Union Potash & Chemical Co. are five in number, namely: (1) regular muriate of potash or KCl of a guaranteed minimum K_2O content of 60 percent; (2) 50 percent muriate containing 50 percent K_2O; (3) granular muriate, which is a coarser fraction made in the refining process and also running 50 percent K_2O; (4) sulphate of potash-magnesia, or washed langbeinite, running 22 percent K_2O or (40 percent K_2SO_4) and 18.5 percent MgO. This product is totally water soluble; and (5) sul-

Duplex rake classifier and hydroseparator treating overflow. A tonnage split of the rake product is made, part going to tabling and part to froth flotation

Potash Plant

Surface plant and refinery at No. 1 shaft. Nearest the camera are, left to right, crushing plant, conveyor gallery, refinery, and storage



Generalized flowsheet of the refinery of the Union Potash & Chemical Co.

phate of potash (K_2SO_4) running 48–50 percent K_2O.

Of the crude ores hoisted from the mine, the salt fraction is being discarded at present in the refining or preparation process in the form of tailings or as waste salt brine solution, both of which are regarded as valueless at the plant.

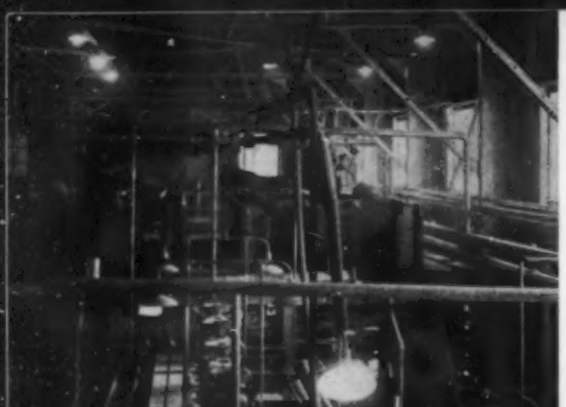
The refining operations begin with the crushing, the first reduction, to -4 in. size, being made underground. The crushed ore is hoisted to the two 250-ton shaft bins from each of which it is fed by a Link-Belt pan feeder delivering to a belt conveyor that enters the crusher building.

Here the ore is further reduced in a Jeffrey Flextooth crusher followed by hammermills of the same make with screening done on Jeffrey-Traylor vibrating screens. The crushed products are delivered by conveyor, after being weighed, to five crushed-ore storage bins, two receiving the sylvinite for treatment and two the langbeinite. The fifth is used for such crude mine-run ore as it is desired to ship directly. These bins stand at the head of the refinery building, several hundred feet from the crusher building. A shuttle conveyor on top of them distributes the ore to the individual bins as required. The crushed products stored are withdrawn from the bins by Link-Belt pan feeders as they are needed.

The order of the principal steps in the treatment given the ore in the refinery is shown in the accompanying flowsheet. The sylvinite ore, containing the potassium chloride (sylvite) and the sodium chloride (halite), is treated by flotation to float the sylvite from the halite. This is done partly on tables and partly in flotation machines, the respective granular and fine products being filtered separately and dried. The langbeinite is washed to remove the halite, or common salt, that accompanies it, and is filtered and dried. Part of it is shipped as washed langbeinite and part of it is ground in brine in preparation for subsequent reaction with part of the fine muriate (also in solution) for the production of potassium sulphate.

In this so-called base-exchange reaction, the potassium chloride and the sulphate of potash-magnesia will react to yield potassium sulphate and magnesium chloride. The latter, in approximately 18 percent solution, is now sent to waste, but presumably, will ultimately be utilized as a basis for the production of metallic magnesium and magnesium chemicals. The rest of the fine muriate, or sylvite, after being dried, goes to storage for shipment.

To describe this refining process in somewhat more detail, the 5- to 8-mesh sylvinite ore drawn from the crushed-ore storage bins is mixed with brine and sent to an FX duplex Dorr rake classifier. This stands outside the mill at some height above the ground. A tonnage split of the rake product is made, part going to tabling and part to froth flotation. The classifier overflow is further treated in an adjacent hydroseparator, the



Froth flotation section of the mill. Rougher cells and cleaners (re-cleaners not shown)

underflow of which joins the portion of the rake sands sent to the flotation machines. The hydroseparator overflow goes to two thickeners for recovery of the brine.

The portion of the Dorr rake product that is to be floated in the machines is delivered for grinding to minus 35 mesh to a duplex Akins classifier in closed circuit with an Allis-Chalmers 6x12-ft. rod mill. The Akins overflow is pumped to eight 54-in. Fagergren rougher cells, the reagents being added in both the pump and the cells. Rougher tails are thickened and filtered, the solids going to the dump. Rougher concentrates are cleaned in four similar cleaner cells, the cleaned concentrate being further cleaned in three re-cleaner cells.

The re-cleaned concentrate is split at 80 mesh in a simplex Akins classifier. The plus 80-mesh size is filtered on a top-feed Oliver filter and dried and sent to storage. The minus 80-mesh material is thickened and the thickened product is filtered on a tank-type Oliver filter. Part of the filtered product is dried and stored for shipment as fine muriate and part is sent to tanks in which it is dissolved for the reaction with dissolved langbeinite in the base exchange process. The sulphate resulting from the base exchange is filtered on an Oliver, dried and stored.

That part of the rake product of the duplex Dorr classifier that is tabled (for the purpose of providing a granular muriate) is first put through a trommel followed by two Jeffrey-Traylor vibrating screens having 22-mesh screens. The plus 22-mesh oversize is conditioned with reagents in a drum mixer that discharges into a rotating 6-way splitter that distributes the feed to six Super Duty diagonal-deck tables from which is recovered the coarse granular muriate that, when dewatered on a Esperanza-type drag and dried, is one of the finished products. It is sent to storage for shipment. The table tails are dewatered on a chain drag and sent to the dump together with the flotation tails where they are spread by a stacker conveyor.

The washing of the langbeinite to remove the halite, or salt, that occurs with it depends on the relative solubility rates of the two minerals in water. The crude ore drawn from the crushed-ore storage bins, by apron feeders, is delivered by belt, after being weighed en route, to a screw conveyor in a trough where it is mixed with water, and the dissolving of the halite begins. The screw delivers to a duplex Dorr rake classifier where further solution of salt takes place and at the same time dewatering is effected, this separating the halite as brine from the undissolved langbeinite. The rake product is filtered on a top-feed Oliver and dried and stored, as washed langbeinite. If wanted for the base-exchange process it is taken from the shift bin and ground in an Allis-Chalmers ball mill in circuit with a simplex Akins classifier, the overflow of which goes to the reaction tanks.

A 150-hp. boiler, with a similar standby unit, furnishes such steam as may be needed for various purposes in the refinery. It is not drawn upon to capacity.

For the various filtering operations mentioned six drum filters in all are provided—two for the tailings from froth flotation and the remaining four for filtering the individual products before drying. These four are arranged so that they can discharge their cake directly on to a conveyor that delivers it to a dryer. Four of the six filters are served by three Roots Connersville blowers and two by an Ingersoll-Rand vacuum pump.

MILL WASTE

Flotation tailings, largely halite, are run by conveyor belts to a dumping point outside the plant from which they are then spread with a stacker conveyor. Mill waste solutions, on the other hand, principally the water used to dissolve the salt out of the langbeinite in the refinery, are now impounded on a 60-acre tract behind a dike or dam 1,700 ft. long with a maximum fill of 13 ft. and having a core wall of puddled mud throughout its entire length. This is 1½ miles from the plant. The purpose is primarily to keep these brines from polluting the wells from which the plant supply is obtained. The tract and connecting ditch are fenced to keep cattle from foundering in the boggy ground. The ditch has likewise been concreted from the mill to the point where it enters upon the tract.

Drying is done in four 5x40-ft. rotating kiln dryers made by Struthers-Wells Titusville Corp. These are parallel-flow dryers fired by natural gas of approximately 1,060 B.t.u. content per cubic foot (guaranteed to be 1,000 B.t.u.). Gas is delivered at the plant at a price ranging from 13c down to 8c per 1,000 cu.ft. The building-up on the inside of the shell of the product being dried is combated in each dryer by the use of a weight suspended on a lever arm over the shell which is made to rise and drop again, by means of a cam on the outside of the shell, striking the shell several times in each revolution.

When dried, the finished products are elevated to temporary storage. Each dryer discharges to an elevator which in turn delivers to one of four 60-ton steel bins set in a row. These bins are known as shift bins and serve for temporary storage in the refinery. From each the product stored is drawn from time to time on to a belt conveyor which delivers it to a 24-in. belt conveyor 360 ft. long that runs to the top of the main storage building where a shuttle conveyor in turn receives it for distribution to the various storage piles. In the temporary storage shift bins mentioned the respective products are allowed to remain just long enough to obtain assays, whereupon they are sent to the proper pile in the storage building. It is from one of these shift bins that part of the washed langbeinite is drawn as needed, to be ground for base exchange.

The dryers are housed at their discharge end for dust-collection purposes, the system having been installed by Union Potash. The finer dust and the gas are removed to the outside of the mill through a 90-ft. duct by means of a 5-in. No. 6 American Blower fan where the dust is caught in a water spray while the gas and steam escape.

Throughout the crushing plant and the refinery wherever dust is likely to be encountered, the workmen are provided with respirators, particularly of the Dustfoe type, and are obliged to use them.

The storage building is 600x102

ft. in plan. It is a steel-frame structure of arch-ribbed type of construction having a corrugated iron roof, and was built by Patterson Steel Co. The outside is covered with No. 22-gage corrugated galvanized sheet.

On the loading-out side of the building, at each end of the concrete floor on to which the finished products stored are dropped in their respective piles from the overhead shuttle conveyor is a 10x10-ft. opening covered by a grid. Midway along the same side is a similar opening, there being three of these openings in the floor in all. Near each opening is a Sullivan 3-drum scraper hoist powered by a 50-hp. Westinghouse motor and operating a box-type scraper. A tripod-mounted floodlight having a 1,000-watt lamp furnishes light for each of these units. By means of these scrapers are reclaimed for shipment, as desired, the potash salts stored, the material being dragged into a hopper beneath each opening. In the chamber below each hopper is a Jeffrey-Traylor vibrating screen followed by a Jeffrey hammermill, this equipment being provided to break up lumps that may be formed by the material setting and hardening while in storage. It may even be that the material stored in the piles on the floor above has to be blasted before it can be scraped into the hoppers. It is because of this possibility that the unusual type of building shown is provided and that a loading tunnel is not employed.

The now re-screened and crushed material is delivered in each of the three crushing chambers to a short conveyor that raises it to ground level and delivers it to another conveyor, in the case of each of the two end units, and to an elevator in the case of the middle unit, all of which deliver respectively to the top of three "loading-out" bins in a covered structure just outside the storage building and midway of its length.

Each of these loading bins is provided with a Jeffrey-Traylor vibrating constant-weight control feeder which delivers either to a conveyor that in turn discharges to an Ottumwa box-car loader and so to the railroad car, or else drops the material into the boot of an elevator which raises it to the top of the building for further screening and crushing, if lumps have formed meanwhile in the loading bins just mentioned. There are two such elevators, each delivering to another vibrating screen followed by a Flextooth crusher. Two box-car loaders are provided.

Water for use in the plant is derived from wells in the vicinity that have been drilled to the water horizon in the Rustler formation at approximately 240-ft. depths. There are four producing wells, varying in depth from 167 to 242 ft. and yielding 190, 270, 375 and 1,080 g.p.m. respectively. The last mentioned flow is from the latest well to be drilled and is the volume noted after 48 hours of continuous operation. These wells are 15 in. (churn-drill) holes with 12½ in. casings. They are equipped with deep-well pumps, respectively, one Byron-Jackson, two Pomonas and one Worthington. Four other wells have been drilled but they either are not productive or are not used at present.

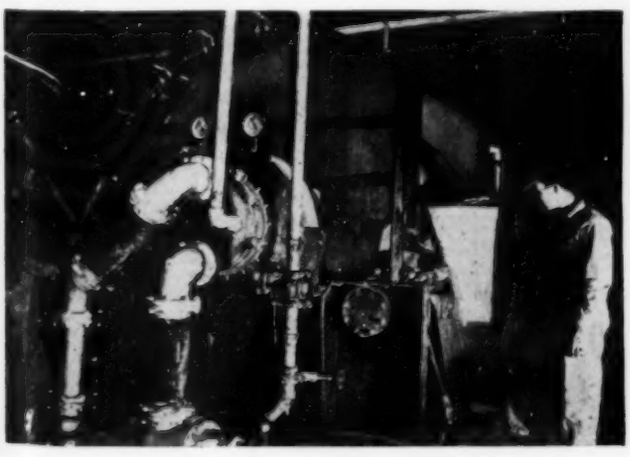
The company's office is close to the gate. Here the General Manager, Harold S. Martin, makes his headquarters and the various department heads have their offices. The building also houses the engineering and accounting departments.

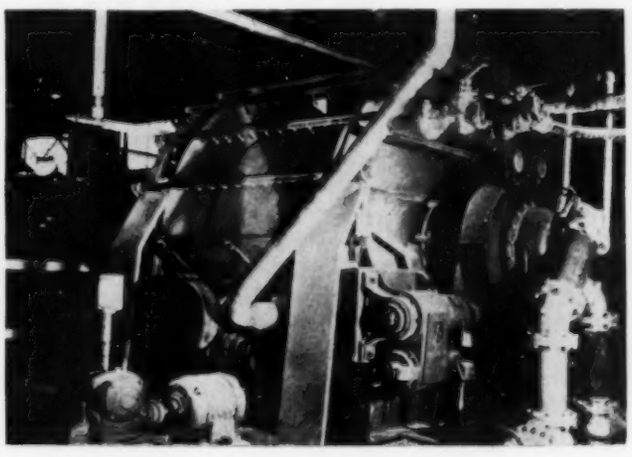
Behind the office is an air-conditioned laboratory housing a sample preparation room, analytical benches and facilities for chemical and metallurgical research as well as the technical library. The analytical work is done in a spacious 28x30-ft. room fitted to handle both shipments analyzed by the official Lindo-Gladding method as well as plant control samples, estimated by the more rapid Sherril centrifugal determination. This room is kept at a constant temperature of 75 deg. F. The building's equipment, modern in design, is especially adapted to problems dealing with the single and double salts of potassium and magnesium.

Comfortable residences for four of the key members of the staff—namely the mine foreman, master mechanic, assistant master mechanic, and the powerhouse foreman — have been erected close to the plant. Aside from these individuals, all of the staff members and office force reside in Carlsbad, 26½ miles away by road, using company cars or their own for the daily trip. Most of the shift workers live in Carlsbad and make the journey in their own automobiles or in buses. A regular service between the town and plant is maintained by a private bus company, in cooperation with the Union Co.

For the privilege of visiting the new Union Potash enterprise and describing its mining and refining operations, the author is indebted to Louis Ware, Chairman of the Board of the Union Potash & Chemical Co., and President of International Agricultural Corporation and to John T. Burrows, President of Union Potash & Chemical Co. and Vice President of the parent corporation.

Below—Two views of the 6x4-ft. bottom-feed Oliver filter which handles the sulphate product of the reaction between fine muriate and langbeinite in the base exchange process





Conditioning Bombproof Underground Spaces for Shelters and Factories

EDWARD LEDOUX *Civil Engineer, Latrobe, Pa.*

Chem. & Met. INTERPRETATION

Our author, a French civil engineer and specialist on air conditioning, was actively engaged before the German occupation of France in the design and conditioning of underground spaces such as are described in this article. His qualifications are exceptional, therefore, for discussing the unusual problems met in such design. Now resident in the United States, Mr. Ledoux is working jointly with Charles L. Mantell, consulting chemical engineer of New York, on the preparation of a forthcoming McGraw-Hill book on applied adsorption.—*Editors.*

With aircraft making it feasible to strike far behind the enemy lines at vital means of production, storage and communication, defense measures today must cover the entire territory which can be so reached. Both active and passive defense are factors in the problem. In European countries the latter has meant not only provision of shelter for civilians, and particularly for industrial workers, but also the bombproofing in underground structures of industrial manufacturing plants, stocks of raw materials and finished products, to the greatest practicable extent.

Such measures introduce many new considerations into construction and design, depending to some extent on the location, peculiarities of the site, and ultimate use of the underground space. Frequently air conditioning may be required to limit humidity and prevent condensation; or it may be necessary to gas-proof the space, either by making it self-contained, or by passing the ventilating air through adsorption apparatus. Combinations of these various functions may also be required.

Underground bombproof spaces, owing to the tremendous heat capacity of the masonry and earth surroundings, remain at an almost constant temperature (50–60 deg. F. in temperate zone) throughout the year. The air is nearly always saturated and frequently supersaturated with fog. This condition is an unpleasant one for people who must remain in the space, and even worse for those called upon to leave and enter frequently. Furthermore, condensation is likely to cause great damage to equipment and material.

Any one of the three methods of removing moisture from air—refrigeration, absorption and adsorption—may be used in the conditioning of underground spaces, the particular type of apparatus best suited depending on the circumstances. Refrigeration and absorption can operate without communication with the outside, but both require water. Refrigeration needs more power than can be supplied by a reasonable auxiliary power plant, while absorption necessitates the maintenance of a supply of chemicals. Adsorption, on the other hand, does not need water, but must communicate with the outside for the discharge of moisture from the adsorbent bed, and products of combustion. Hence, large units cannot be operated safely during gas attacks. Furthermore, adsorption requires the maintenance of a supply of fuel oil for activation. All systems demand power for the fan, of course, but the amount is not too large to be taken care of by an auxiliary power plant.

The peculiarities of underground spaces dominate the problem of air conditioning. First, the temperature is low, making conditioning more expensive, since comparatively large flows of dehumidified air must be supplied at a very low dew point. Secondly, temperature variations are opposed by the considerable thermal inertia of the walls, thus preventing economical humidity reduction through heating. Thirdly, much moisture is given off by the walls, a major factor in the drying capacity required.

High humidities in underground spaces result from leakage, intake of moisture through ventilation, moisture discharge by persons in the space, evaporation of water in bulk and, finally, evaporation of water from the surfaces of porous masonry. The last is generally the most important source, perhaps more important than all of the others together.

Building materials used in underground spaces are always more or less pervious to humidity, although the degree of porosity can be decreased by proper materials, such as special waterproof concrete. The vapor pressure of the water on the surface is that corresponding to the temperature of the surface layer of masonry and the air in contact with it, if not conditioned, is saturated and of a temperature equal to that of the walls. That is to say, on starting up the conditioning equipment there is no surface evaporation, but as conditioning proceeds the relative humidity of the air is reduced and surface evaporation increases rapidly.

In an underground space already completed the amount of surface evaporation per unit of time is controlled by three factors: the total wall area (over which the air conditioning engineer has no control); the vapor pressure difference between air and wall surface; and the coefficient of vapor transfer. Regarding the second factor, in the important special case where the conditioning system produces no temperature rise, the evaporation is substantially proportional to the relative humidity lowering. Hence, for a given reduc-

tion in relative humidity, the lower the temperature of the space the less the evaporation. This points to the advantage of low temperature and elimination of unnecessary dehumidification.

In the case of the last factor, the coefficient of vapor transfer is least in the stationary air at the wall surface, which emphasizes the need for disturbing this air as little as possible, through the minimizing of drafts and the use of low register velocities. Natural convection currents must be minimized also, for which reason the temperature difference between walls and air must be as little as possible.

Unfortunately, considering the importance of masonry porosity as a source of moisture in underground spaces, few data are available to permit an accurate estimate of the requirements. For one thing, capillary humidity comes into play only when conditioning is in operation; for another, existing plants are as yet few in number, although rapidly increasing in importance.

The problems of underground conditioning, as has been noted, vary considerably with the type of use of the space. At the risk of over-simplification, perhaps the uses can best be considered in the three classifications of: storage spaces, shelters, and factories. Underground storage rooms generally are of large internal volume, with personnel occupancy so small a factor as to be negligible. Conditioning in this case is for the purpose of preventing condensation, and the prevailing temperature, within limits, is immaterial. Lowering of the humidity can ordinarily not be accomplished economically through heating, owing to the considerable thermal inertia of the masonry and surrounding earth, and to the continuous arrival of supplementary moisture and the increasing rate of evaporation, due to heating. Therefore, heating will not be considered here. More economical is the method of lowering the vapor pressure at constant temperature.

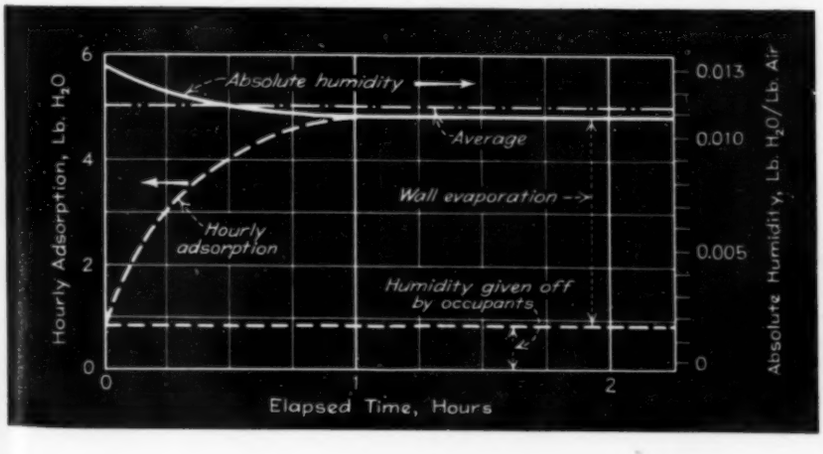
STORAGE SPACES

The most economical type of ventilation is, of course, the closed-circuit method, which is suitable for storage rooms. Under this system the capacity of the dehumidifying equipment decreases continuously as conditioning proceeds, while at the same time, with lowering of the humidity of the air, increased surface evaporation takes place, so that within a comparatively short time equilibrium is reached and the entire drying power of the apparatus is used in condensing capillary water as rapidly as it is evaporated from the wall surfaces. Since the initial dew point of the air is very low, owing to the low temperature of the space, the dehydration equipment must be capable of delivering extremely dry air (0.0015 lb. moisture per pound of dry air, or less) to give satisfactory results.

Conditioning of underground storage rooms is therefore out of the range of refrigeration. Although absorption with calcium chloride can give a lower dew point than refrigeration, it is still too high, and furthermore requires cooling water. Adsorption with silica gel or activated alumina gives the desired solution to the problem because of the extremely low dew point obtainable, because low temperatures favor adsorption, and because cooling water is not necessary. The low temperature can be held because the actual heat input balances the heat of evaporation of the surface moisture (except for the accumulated heat of activation released at the beginning of each cycle).

The accompanying figure shows the great importance of capillary evaporation, which must not be underestimated. The case illustrated is by no means exceptional, and shows the absolute humidity decrease in an underground volume of 16,000 cu.ft., conditioned by adsorption with a closed circuit of 6,000 cu.ft. of air per hour, delivered at 0.0003 lb. of moisture per pound of dry air, and an average room temperature of 68 deg. F. During the test five persons were present. After about one hour no further decrease in humidity of the air took place, and at this point moisture removal exactly balanced wall evaporation plus the moisture given off by the people. With an initial adsorption capacity of 5.72 lb. per hour, it was not possible to go below 0.011 lb. of moisture per pound of dry air, or about 70 percent relative humidity. Without wall evaporation, a relative humidity of about 40 percent could have been reached, although this would have taken more than 2¼ hours, owing to the inevitable capacity decrease of the equipment during operation.

Plot of absolute humidity decrease in an underground space conditioned by adsorption, superimposed on curve of moisture adsorption rate



SHELTERS

Shelters, except for protection against gas attacks, present quite a different problem from that of storage spaces, owing to the presence of persons in the conditioned space. Still, considerations of thermal inertia of the walls and capillary evaporation remain dominant factors. The conditioning requirements differ according to the occupations of the persons present, especially whether they are active or inactive. The former case occurs in underground factories.

Two distinct methods are used for ventilating gas-proof shelters. In the closed-circuit method, breathing requirements are met either by regeneration of the internal air, with carbon dioxide absorption and oxygen supply, or by expansion of compressed air stored in high pressure cylinders which are recharged by a compression plant between attacks. These two systems may, of course, be combined.

In the open circuit system, breathing requirements are met by the introduction of fresh air from the outside, after stripping it by proper methods of all toxic substances. The closed circuit system insures protection against any type of gas since it is entirely independent of the

outside atmosphere. On the other hand, it is more expensive than the open circuit. Another advantage of the latter is that there is no consumption of conditioning material in case of a false alarm. Naturally, maximum safety can be assured by the combination of the two systems. Thus, if open circuit operation must be abandoned owing to clogging of the activated carbon filters or wrecking of the fresh air intake, closed circuit operation can immediately be used.

Atmospheric air can be rendered unfit for breathing and made deadly by the dispersion of poisonous substances in three different forms, which may be used singly or in combination. These include vapors, liquids and solids. While such substances are ordinarily referred to as "gases", gases themselves cannot be easily liquefied at atmospheric temperature and reasonable pressure and hence are not readily conveyed in the small volumes required for loading into shells or bombs. Toxic vapors, since they can be easily liquefied, are readily adsorbed and for this reason activated carbon is effective in practically all cases.

Poisonous liquid mists or fine solid particles (toxic smokes) are used for three principal reasons: (1) Through their use it is possible to infect not only the air but also the ground and other objects, causing damage to any part of the body coming in contact with the material. (2) Activated carbon beds are ineffective against fine mists or solid particles. (3) Such substances can be designed to clog activated carbon beds and put them out of service. Air washing and electrical precipitation are insufficient to remove these materials completely from air, making it necessary to employ extremely fine filtration. Such substances as silk, wool or felt, either impregnated or not so treated, may be used, although the best medium is filter paper or cardboard specially processed for the purpose. Filters are, of course, placed before the activated carbon adsorbers.

Although most vapors can be neutralized or decomposed chemically if the proper reagent is used for each substance, this method is too specific for chemical warfare since the nature of the toxic substances to be used cannot be known beforehand. Apart from this is the question of supply of a variety of special chemicals or impregnated carriers. Hence adsorption is the best solution at present, because it will stop practically any vapor used in chemical warfare. The degree of protection, of course, will vary considerably with the nature of the vapor, its concentration in the air, and with the various factors controlling the break point of the adsorption bed.

Activated carbon is the only adsorbent used because of its high affinity for chemical warfare substances and its low affinity for water vapor. This material will, however, fail to adsorb carbon monoxide under atmospheric conditions. Hence a Hopealite bed should be installed for protection against this gas which is liberated by the explosion of bombs.

The water content of an activated carbon bed is an important factor in its performance. When the carbon is damp, the effect is to reduce the break point concentration to a variable degree, according to the substance being adsorbed and its concentration in the atmosphere, although the adsorption efficiency is hardly affected. Hence, as a general rule, activated carbon adsorbers should be kept dry and the inlet and outlet valves closed when the adsorber is not in use. However, since some gases will hydrolize under the influence of moisture, a damp activated carbon may be preferable.

CARBON BED REACTIONS

One factor which is difficult to foresee and provide for is the possibility of chemical reactions in the carbon bed proper—either accidental or planned by the enemy. Possible desorption of the bed is also a serious menace which must be kept in mind both in designing the equipment and during operation. Such hazards as these are disadvantages of the open circuit system.

As already stated, the type of protection afforded by a given adsorber depends on the various factors controlling the break point. So many of these factors are unknown, owing to the impossibility of predicting the nature of the gas and its concentration, that the amount of adsorbent to be installed is a matter of speculation. Each nation has its own specifications regarding characteristics of the carbon to be used, its granulation, humidity and the quantities to be used. These specifications vary considerably, since they are based on different conceptions of probable chemical warfare and the possible efficiency of bombardment by the enemy. Variables entering into the picture include the distance from enemy bases and the strength of active defense available. Government specifications are, of course, kept secret since there is no point in letting the enemy know what conditions have been prepared for.

The problem of conditioning gasproof shelters and other underground spaces, is quite a different one from that encountered in conditioning surface buildings for peace-time activity. In the latter case, the object is to provide the people present with the most comfortable and healthful conditions. In the case of underground spaces, however, requirements may vary from those of storage spaces, with practically no occupancy; through shelters where the occupants have no particular duties to perform, and simply wait for the end of the danger period; to underground factories where the occupancy and activity levels may be high. In the case of simple shelters, the engineer's problem is to protect the maximum number of lives for a given expenditure, comfort being secondary since actual occupancy is limited to the duration of the attack and its after effects. Obviously, it is preferable to provide protection for eight or ten hours under uncomfortable conditions, than to reduce the period of safety to say one hour at a good degree of comfort.

In underground spaces strictly for shelter, the vital consideration is economy of fresh air which may be reduced without danger to 70 cu.ft. per hour per inactive person. Hence, smoking in shelters should be prohibited and lights should be electric. Since the breathing rate increases considerably with the degree of activity, occupants should all be seated and minimum physical activity assured. Minimum activity will not only reduce oxygen consumption, but will make uncomfortable conditions more bearable. Shelters must, of course, be as nearly air-tight as possible, so that the introduction of fresh filtered air will permit maintaining a pressure difference of 0.2-0.4 in. of water between inside and outside. This requirement is not as easily met as might be thought, even when doors and other openings are properly designed, since experience has shown that masonry is appreciably pervious to air. This condition can, however, be improved by special internal coating of the walls.

Shelter conditioning introduces very little fresh air so that temperature and humidity will readily increase and body odors will not be eliminated. Discomfort will, therefore, result although dangerous conditions under which the body cannot eliminate enough heat will not be

(Please turn to page 87)

Protecting Industrial Plants From Magnesium Fires

ARTHUR B. GUISE
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Chem. & Met. INTERPRETATION

Latest available information on the extinguishment and control of magnesium fires and those resulting from the magnesium-body, thermite-igniter type incendiary bomb, has been assembled here by the author. The article also contains the results of recent experiments conducted at the Factory Mutual Test Station.— *Editors.*

LATEST published information is the basis of this article, together with unpublished data obtained during recent experimentation, and on large scale fire tests at the Factory Mutual Test Station in connection with studies on the proper control of magnesium fires in industry [3, 4]. It is necessarily incomplete, since both incendiary bombs and to some extent the methods of extinguishing them may fall within the category of military secrets and information on recent developments cannot always be published.

Information on aerial incendiary bombs has been published recently in the United States, and British handbooks on the subject are available, but the development of new extinguishing agents for use on these incendiaries suggested the desirability for a discussion of the subject with emphasis on the protection of industrial plants.

The most widely used aerial incendiary bomb at the present time is the magnesium-body, thermite-igniter type, with which we have become thoroughly familiar as a result of the mass air raids over Britain. News reports indicate that incendiary bombs containing crude oil have also been used by the Germans to a limited extent. Phosphorus and thermite bombs have been used in the past, but their use so far in the present war apparently is negligible.

MAGNESIUM BOMBS

Magnesium is well adapted for use in incendiary bombs because it is light and suited to airplane transportation, yet burns in the form of the solid metal, so that it can be used for making the structural parts of the bomb, thus cutting down inactive material to a minimum. Its temperature of combustion is so high (about 3,300 deg. F. or 1,850 deg. C.) that small bombs, which can be broadcast in large numbers, are effective in starting fires in combustible materials of all kinds. Burning magnesium cannot be extinguished by water and other commonly used extinguishing agents. Unless properly handled, water coming into contact with the burning metal may cause a violent explosion.

The German magnesium, or "Elektron," bomb is made in sizes ranging from 2.2 to 55 lb. The smallest size, used for indiscriminate bombing, consists of a tube with a 0.4-in. wall, 9 in. long by 2 in. outside diameter, made out of an alloy containing 80 percent magnesium[2]. The tube is filled with thermite in the German bombs, and is fitted with sheet-iron tail fins, to steady the flight, and a magnesium alloy nose piece containing the firing mechanism[2]. The bomb does not explode on striking, but sputters violently for the first half minute or so during the thermite reaction, shooting flames and bits of molten metal out of vent holes. It then burns more quietly for about 15 minutes.

Dropped on to the roof of a dwelling, the bomb is likely to penetrate it and be stopped by the attic floor. It will start a fire here, if it strikes close to combustible materials, and then may burn through and start another fire on the floor below.

The usual heavy roof of plank-on-timber or concrete-slab construction of industrial establishments will generally stop the incendiary bomb. Should it break through a skylight and land on a plank floor, it is unlikely to burn through the floor and start another fire on a lower level. Should it land on a concrete floor, combustibles in the vicinity may be ignited by burning particles thrown out during the thermite reaction or by burning magnesium thrown around in the later intermittent "pops" caused by reaction with the moisture in the concrete.

ORDINARY EXTINGUISHERS

Burning magnesium combines with the oxygen of water, liberating hydrogen which immediately burns. If the water is sprayed on the burning metal, the magnesium may burn more vigorously but probably quietly; if the water is poured on, the reaction will take place explosively. Magnesium also burns in carbon dioxide, liberating carbon monoxide. It will react vigorously with carbon tetrachloride the basis of the extinguishing agent used in the vaporizing-liquid fire extinguisher, forming magnesium chloride. Foam and dry compound (mainly sodium bicarbonate) fire extinguishers are also ineffective because of reactions with burning magnesium.

Magnesium will frequently continue to burn under coverings of sand, slag, pumice, steelmite pumice, ash, kaolin, talc, and asbestos, fed by any moisture that these materials may hold, by the water of crystallization, and also by direct reaction with the materials. Iron filings or turnings have been recommended in the past, and are effective extinguishing agents when in proper condition. However, practical experience has shown that iron filings or turnings eventually rust to a hard mass which if broken up and applied to burning magnesium will cause a thermite reaction.

A patented material for use on incendiary bombs and other metal fires, known as "National DX Powder," has been developed in Britain[10]. This extinguishing material contains as high as 50 percent of a combustible solid which becomes ignited when the powder is applied to burning magnesium, although it is claimed that continued application of the powder will extinguish the flames. It is apparently **not yet** readily obtainable in this country.

More recently, another material suitable for extinguishing all kinds of burning metals, as well as phosphorus, has been developed in the United States by the Pyrene Manufacturing Co. and the Dow Chemical

Co., and is now commercially available here and in Canada. This proprietary compound, known as "Pyrene G-1 Powder," is composed of materials which are essentially nonreactive with burning metals or phosphorus. Among other ingredients, it contains certain new highly complex chemical compounds, which vaporize under conditions of use and form a dense inert gas blanket through and over the layer of extinguishing powder. Having no abrasive action, it can be safely used around machinery. At present, the powder is applied to the burning material with a scoop or shovel, thereby excluding air and extinguishing the fire.

HANDLING BOMBS

The purpose of an air raid using modern magnesium incendiary bombs is to start a large number of fires simultaneously. The bombs themselves can usually be readily extinguished if proper methods are used, and the resulting fires, being ordinary ones, can be successfully fought by means of standard fire extinguishers or hose streams. It is imperative that the bo bs be quickly discovered and extinguished.

After the igniter has burned out, the bomb is only a piece of burning magnesium, and does not form as intense a fire as a pile of magnesium turnings. If it lands on a concrete floor, it is only necessary to cover it with G-1 Powder and then go on to the next incendiary. If the bomb lands on a wood or other combustible floor, the following procedure is advisable: Cover the bomb with the extinguishing powder, then shovel it into a pail containing a 2-in. layer of powder, after which it can be safely removed. Or, if sufficient pails are not available, spread a 2-in. layer of the powder on the floor and shovel the bomb, covered with powder, on to this protective covering, and go on to other bombs, returning later to "mop up."

In cases of emergency, sand may be used in place of G-1 powder. However, it cannot be too strongly emphasized that the sand must be dry and free from organic material, and must be kept that way, which is practically more difficult.

If the incendiary has ignited considerable quantities of combustible material in the vicinity, so that it is not practicable to approach it and cover it with powder, the secondary fires must be fought first. All types of ordinary first-aid fire-extinguishing equipment can be safely used on the fires surrounding the bomb, but care must be taken to avoid allowing a jet of water or vaporizing liquid to strike the bomb since this may cause an explosion and scatter the burning metal, thus starting more fires.

A water spray is effective in wetting down combustibles in the immediate vicinity of the incendiary without dangerously increasing the intensity of the magnesium fire. Such a spray is provided by a garden-hose nozzle but dependence must not be placed upon the customary water supply which may be disrupted by high explosive bombs.

Standard hand fire extinguishers, such as the soda-acid or the water types, including pump tanks, are useable because a coarse spray can be produced by holding the thumb over the nozzle. They have the advantage of one-man operation, but a sufficient number of units should be available to permit a single man to reach several quickly from any point. Pump tanks can be readily refilled from buckets.

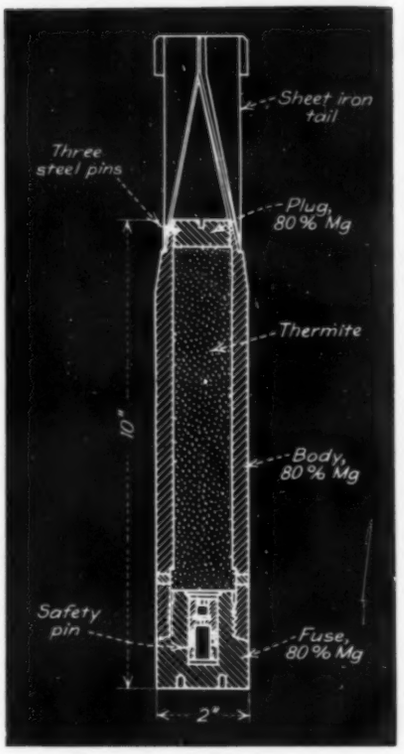
In England, the "stirrup pump," which pumps water out of buckets through 30 ft. of garden hose, is being used. It requires two or three men for its operation but it permits the hose operator to climb over obstacles and on to roofs for extinguishing bomb fires.

The provision of an adequate supply of extinguishing powder and first-aid fire extinguishing equipment, and use of these by trained squads, will provide good protection against fires started during incendiary bomb raids. Existing plant fire brigades form an excellent nucleus for the instruction of all plant employees for defense against incendiary bombs, both at the plant and at home. In this instruction, actual operation of the fire extinguishing equipment by every trainee is of basic importance.

By actual test we know that the discharge from automatic sprinklers will serve to extinguish fires in surrounding combustibles without dangerously accelerating the burning of incendiary bombs. However, because of the possibility of damage by explosive bombs to yard mains, elevated tanks, etc., final dependence cannot be placed on an automatic sprinkler system.

INDUSTRIAL METAL FIRES

In this country, we have not yet had to concern ourselves intensively with home defense against magnesium bombs, but we do have to contend with fires in plants where products are being made of magnesium alloys and, to a lesser extent, where aluminum, zinc, and other more difficultly ignited metals are being produced or processed.



German Elektron magnesium incendiary bomb (Drawing from British Government Air Raid Precaution Handbook No. 9)

In such plants, the necessity of training workers in the latest technique of fighting metal fires is obvious. But it is equally important to prevent all fires, because fires breaking out at any point may involve the flammable metal. Then, if the fire department has to be called, the firemen will have to use hose streams with greatest care to avoid serious explosions. In fact, buildings containing considerable quantities of magnesium have burned down, because the fire fighters could not effectively use water on them.

The remedy for this situation lies in making departmental fire brigades a major line of defense against fire in all plants, especially where serious metal-fire hazards exist, so that fire breaking out anywhere will be promptly and effectively handled. To do this, an ample supply of the right types of approved fire extinguishers should be provided, all workers should be thoroughly trained in their use, and an effective system of inspecting, maintaining, and recharging the extinguishers should be organized.

OTHER INCENDIARIES

Petroleum Bombs—Bombs of this type consist of metal drums containing a petroleum product which may be in the form of a gel, such as a mixture of soap and oil[8]. Although the oil may burn fiercely, this type of bomb is not very efficient as an incendiary, and is believed to be used chiefly for marking targets. It can be extinguished by any extinguishing agent suitable for use in Class B (flammable liquid) fires, air-foam devices being particularly useful, according to reports from England.

Thermite Bombs — Incendiary bombs with thermite as the chief constituent have been employed in the present and in the previous World War, but apparently are not now being used to any great extent. There is, of course, no way of stopping the thermite reaction, and the problem of handling bombs of this type resolves itself into effective handling of the secondary fires.

Phosphorus Bombs—Yellow phosphorus will burst into flame when it comes into contact with air, and although it can be extinguished readily with water, re-ignition takes place as soon as the water evaporates. Its chief present use for incendiary purposes seems to be by the British in connection with the so-called "calling cards" used to start fires in dry crops and other widespread, readily ignited materials. A calling card is said to consist of a small piece of paper, saturated with yellow phosphorus, and attached to small sheets of celluloid. The cards are kept moist until dropped from the plane and ignite spontaneously on drying out.

Further information on the mechanical, military, and public defense aspects of incendiary bombs will be found in the following references.

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6. "Fire From the Air", by J. Enrique Zanetti. Columbia University Press, 1941.
7. "The Work of the Fire Service During and Following Air Raids", Educational Bulletin No. 3, Intern. Asso. Fire Chiefs, New York, 1940.
8. "Air Raids", British Ministry of Home Security, H. M. Stationery Office, London, 1940.
9. "Incendiary Bombs and Fire Precautions", Handbook No. 9, British Ministry of Home Office and Home Defense.

(Reference 8 and 9, as well as a large number of other publications on Air Raid Defense, can be obtained from British Library of Information, 50 Rockefeller Plaza, New York, N. Y.)

10. Metal Fires and Their Extinction, *Light Metals*, November 1939.
11. "Fire Defense Programs", Bulletin, National Fire Protection Association, Boston, Mass., May 1, 1941.

UNDERGROUND CONDITIONING

(Continued from page 84)

attained, thanks to the thermal inertia of the walls and their limiting effect on temperature rise. Furthermore, the walls will cause condensation of the moisture and supply effective cooling to the occupants by radiation. A state of practical equilibrium will be reached after a period of rather rapid temperature rise. Roughly three-quarters of the total rise will occur in the first hour, while practical equilibrium will be reached in, say, eight hours.

Only in exceptional cases, when the initial temperature of the air and of the walls is high, and the density of occupancy is considerable, will the cost of cooling or dehumidification be justified for shelters housing inactive people. On the other hand, where people have to carry out a certain amount of work inside shelters, as for example in public service offices, telephone exchanges, military headquarters, hospitals and factories, proper work cannot be performed in the uncomfortable atmosphere permissible in ordinary shelters. Hence the maintenance of more comfortable conditions is necessary. A further factor is that such spaces are likely to contain equipment such as telephone apparatus, manufactured products, raw materials and machinery, which cannot stand saturated air.

In other cases, where occupancy is low and scarcely any heat is given off (as in storage spaces), temperature need not be controlled by the conditioning apparatus and dehumidification will suffice. The dehumidification load here will be that of taking care of evaporation from the walls, plus a larger quantity of fresh activated-carbon-filtered air than in the preceding case. The dehumidification system must be designed to consume a minimum quantity of cooling water and, if necessary, still be able to do some conditioning if the water supply is shut off. Adsorption meets this requirement. Where a moderate amount of heat is given off in the space, a water after-cooler may be provided, but the amount of water consumed will be small and shutting off of the supply will not materially reduce the dehumidification capacity. The only result will be a slight temperature rise limited by the wall effect.

The problem, with factories where considerable heat is given off by machinery and lighting, is quite different. In such a case, the equilibrium temperature may become excessive in spite of the enormous heat loss to the walls, and the availability of cooling water is a necessity. Otherwise it will be impossible to eliminate heat from the space without communication with the outside and without putting a considerable extra load on the activated carbon filters, such as would occur if air were used as a carrier for the heat.

Conditioning of factories in most cases is well within the scope of refrigeration and absorption, since low temperature cannot be economically maintained. For a given relative humidity, the prevailing dew point is necessarily higher than in the previously considered cases. As a matter of fact, such processes in many cases are preferable to the more costly system of adsorption since here an extremely low dew point is not a necessary condition; and the advantage of operation without water need not be considered when cooling is necessary.

Wherever people are to be sheltered underground, provision must be made to take care of ventilation in case electric power is shut off. An auxiliary electric system with storage batteries may be provided for lighting, while auxiliary human power drive will serve for the fans. For small installations, the fans may be hand-cranked, but a better arrangement is a stationary cycle drive, either solo or tandem. The power that can be supplied by an average man pedaling is about 0.25 hp. so that a tandem can operate a 0.5 hp. fan. In view of this rather small power output, the importance of reducing the resistance of pre-filters and activated carbon bed to an absolute minimum is evident. Of course, the increased activity of the cyclists must be taken into account since their breathing requirements are enormous.

For very large spaces, ventilation is too important a factor to be entrusted to the cycle drive, and an auxiliary power plant with diesel engines and generators is justified for both lighting and power. In such a case, obviously, resistance of the filters becomes of little importance.

Bins holding 5,000 pounds of raw resin are stacked by a telescoping lift

Modern Plant Makes

J. R. CALLAHAM *Assistant Editor, Chemical & Metallurgical Engineering*

Chem. & Met. INTERPRETATION

The Resinox plant, latest and largest of Monsanto's units for producing resins at Springfield, Mass., typifies the modern in process plant lay-out and design. Cleanliness, safety and comfort of employees, as well as liberal use of automatic and remote control of operations and processes, are major considerations in this plant, the important features of which are described below. —*Editors.*

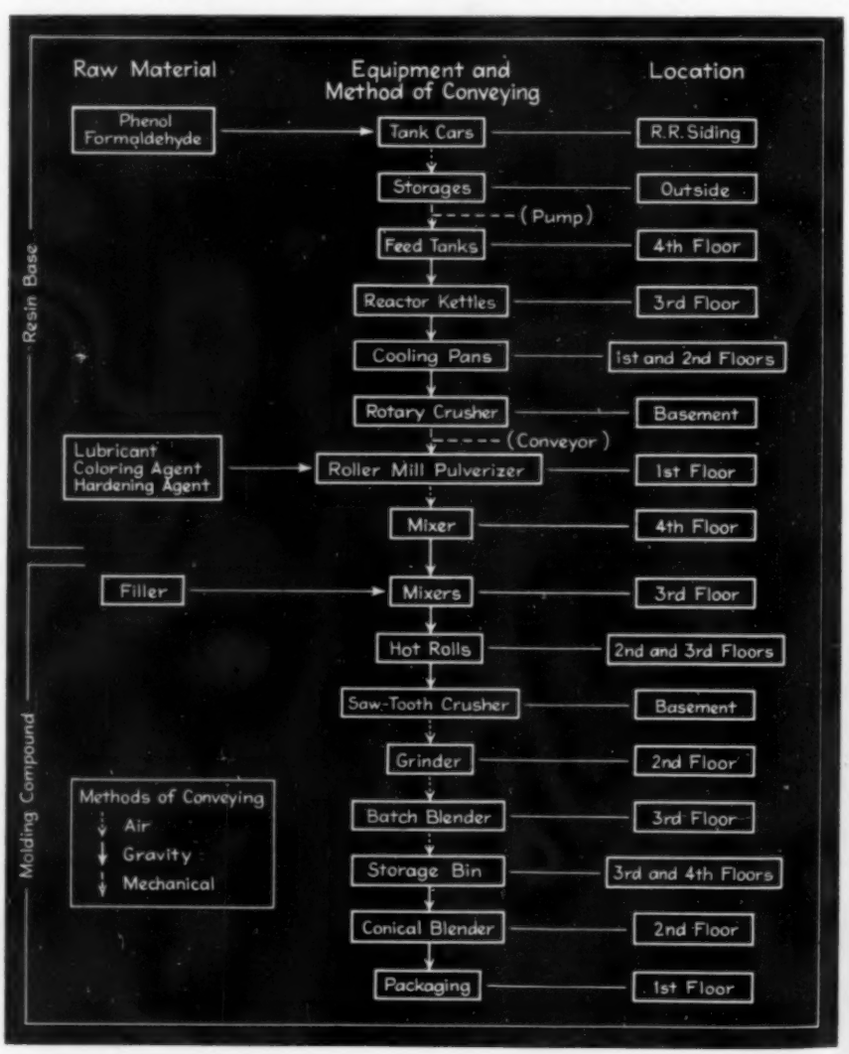
CHARACTERIZED by modern design, streamlined operations and cleanliness, the new Resinox plant of the Monsanto Chemical Co. at Springfield, Mass. has now become an operating unit of the largest single group of plants in the United States for the production of various plastic raw materials. This recent addition, estimated to have cost in the neighborhood of $1,000,000 and to have an annual capacity of 15,000,000 lb. of phenol-formaldehyde molding compound, has been operating at near capacity for the past four months, although it was not officially dedicated until April 29th.

The Resinox Corp., a leading producer of phenol-formaldehyde resin and molding materials, was acquired by Monsanto in 1939 and absorbed into the company's Plastics Division. The new Resinox plant, replacing the one at Edgewater, N. J., was made necessary by the rapidly expanding use of Resinox in both peace-time and defense industries. So rapid has been this expansion that rumors already have it that Monsanto plans, as soon as the formaldehyde raw material situation is clarified, to make an addition to the plant that will increase output by at least 50 percent, or to approximately 22,000,000 lb. of molding compound per year. Springfield, with the new Resinox plant now added to Monsanto's capacity for producing six other major resins here, is undoubtedly the plastics-producing center of the country. The Resinox plant alone can produce 20 different phenol-formaldehyde base resins from which at least a hundred different molding compositions can be compounded.

The increased productive capacity of the new plant is important at this time, as it will be able to supply molding composition to release more than the equivalent weight of strategic metals such as aluminum, zinc and magnesium.

Largest in the Springfield group,

Chart showing sequence of flow and importance of air and gravity in conveying



Phenolic Resins at Springfield

the new plant is a five-story building constructed of steel-reinforced concrete, faced with brick on the outside and tile within. Wide bands of windows completely encircling each floor, aided by the set-back design of the building, insure maximum natural light, cleanliness and safety. The plant has a window area of approximately 26,000 sq.ft., giving a minimum of about 1 sq.ft. of window area per 30 cu.ft. of plant volume. In addition, a modern ventilating system incorporating filtering at intakes and dust collectors at the three exits, insures a clean and a dust-free atmosphere. Even ordinary cleaning is done by powerful vacuum hoses which are located throughout the plant. As a result, this plant, which ordinarily would be hot and dusty, is conspicuous for its cleanliness and comfort.

Phenol and formaldehyde raw materials are stored in seven outside steel tanks, of which those for formaldehyde are rubber-lined to prevent corrosion. These tanks have a capacity of 10,000 gal. each. Compressed air is used for unloading both the phenol and formaldehyde from tank cars, but pumps operated by remote control are used for transferring the materials from the storages to the charging feed tanks on the top floor. Both tank cars and storages are insulated and equipped with steam coils to keep the materials fluid. For this purpose 40 percent formaldehyde must be kept above 60 deg. F. and phenol at about 115 deg. F., which is accomplished by automatic heat regulators. The use of Monsanto synthetic phenol guarantees a high-purity product.

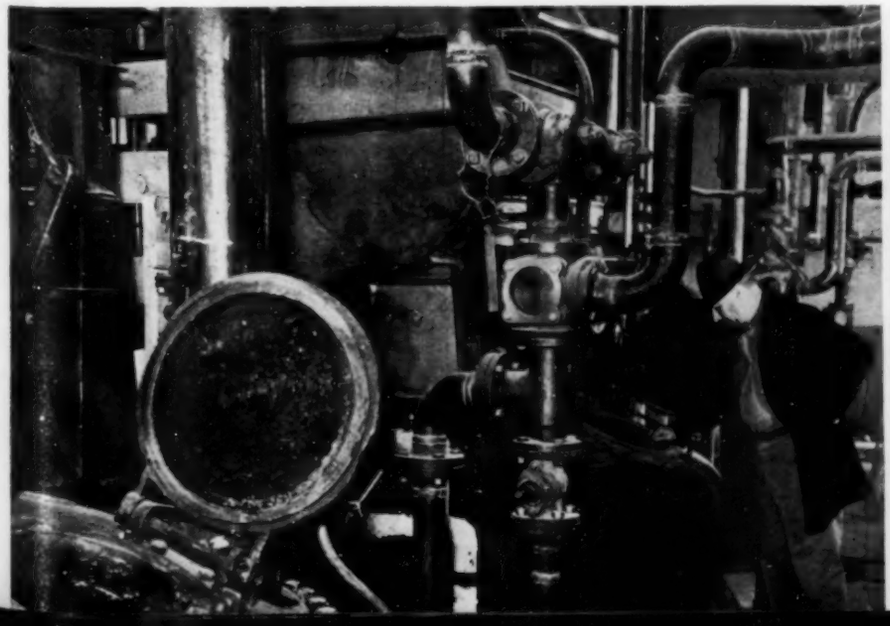
Manufacture of Resinox starts in a bank of giant steam-jacketed steel kettles suspended between two floors. Capacity of these kettles ranges from 2,000-10,000 lb. of finished product. Into these reactors go solutions of phenol and formaldehyde which have been weighed automatically by the use of photoelectric cells, and a trace of sulfuric acid to catalyze the reaction. Steam of 150 lb. pressure is turned into the jackets, the kettles are subjected to about 29½ in. vacuum and for several hours, depending upon the type of product desired, the materials are digested and simultaneously churned by slow-speed anchor-shaped agitators rotated by explosion-proof motors. Maximum temperature attained in the kettles depends upon the type of resin, and may range from 175–300 deg. F., with dropping temperature at about 175 deg. F. All temperatures and pressures are regulated by automatic and remote control.

When the mass has reacted sufficiently to form a phenol-formaldehyde resin having the consistency of a heavy syrup, a large valve in the bottom of the kettle is opened and the hot resin pours out onto a steel floor, which is really a pan built into the building. This pan-like deck is canted at an angle so that the resin spreads quickly and fills the entire area to an average depth of 2–4 inches. Cooling is accomplished in about 4–6 hours and is aided by natural air circulation from the floor below. Two such floors are provided and if the upper floor is filled with one batch and another kettle is ready to drop, a hole is opened in the floor under the mouth of this kettle and the material pours through the hole to the floor below.

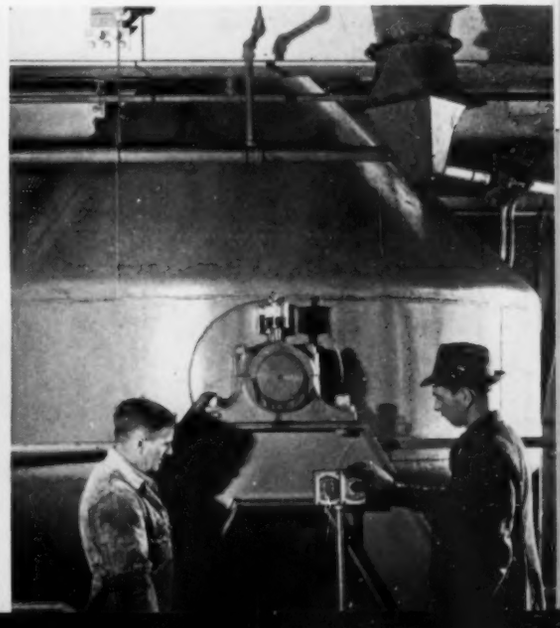
After cooling, the solid base resin, which shows no tendency to stick or corrode the steel floor, is easily broken up and shoveled into chutes which direct it down into the basement. Here it is dumped into portable bins of 5,000 lb. capacity. An electric tilting-tiering fork truck carries the container with its load to the scales where it is weighed automatically and deposited into a powerful rotary-type crusher which reduces it to about ¼–½ in. particle size. From here a conveyor carries the material to the roller mill pulverizer located on the first floor. As the lumps of resin drop into the chamber of this mill they are caught between huge high-speed steel rollers and are reduced in a few seconds to a particle size of 200 mesh or finer. A powerful air blast then carries this powdered material out and up to the fourth floor to a mixer where a lubricant is added to prevent sticking during molding. Also added here, in the case of two-stage resins, is the hardening agent, such as hexamethylenetetramine.

This resin compound is now ready for processing into molding material, which is begun by feeding the resin

Remote control regulates digest conditions in this bank of kettles



Operating a giant conical blender by push-buttons



compound, coloring matter and filler into big mixers preparatory to rolling. Fillers may be wood flour, walnut shell flour, mica, (for high electrical insulation and dielectric properties), or cotton flocks to give a product of high impact resistance. However, probably about 90 percent of phenolic molding compounds are wood-flour filled in proportions as high as 50 percent of the total molding composition. The mixers are ribbon type for black or brown mixes and ball mill for colored mixes. After mixing the batch is dropped by gravity from the third floor to a series of heated rolls similar to those used in rubber making. On the first pair of rolls, the temperature of one is held at about 220 deg. F. and the other at about 310 deg. F., this differential being maintained to prevent sticking of the material to drum surfaces. Towers to provide cooling water to the rolls, as well as condensing water to the kettles, are located on the roof of the building.

Heat and mastication soften the resin and all ingredients are thoroughly homogenized, the net result being to advance the stage of cure. The length of time the resin is allowed to remain on these rolls varies widely depending upon the type of material to be produced, as these time and temperature factors control the flow and other properties of the finished molding compound. The material is easily stripped in heavy, thick sheets from the rolls by a lever-operated knife arrangement and then falls to another set of steel rolls below, which further advances homogenization and cure. This second set of rolls serves to improve quality of the product as well as to increase capacity and hence avoid a production bottle-neck. The rolled material is then dropped to the basement and into a saw-tooth crusher which once again reduces it to chips. It is at this stage that use is made of a novel, quick method of cooling the hot material after it has been rolled and before grinding in contrast to the usual practice of time-consuming cooling by conveyor belts. The method actually used in the Resinox plant does the necessary cooling in a matter of seconds.

PNEUMATIC CONVEYOR

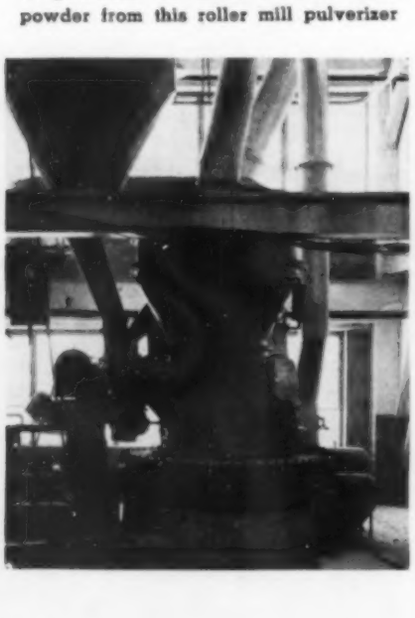
After grinding and screening, the particles are carried up several floors through ducts by air where they are blended to assure uniformity for each batch and then stored in large-capacity closed bins. At this stage of the pneumatic conveying system, a clover-leaf type of pump is used for high-velocity, high-pressure movement of the material through a 4-in. line at the rate of approximately 10,000–12,000 ft. per min. For such velocities and pressures, very little air is necessary and the flow is practically in solid form. The molding compound is now complete but for one more operation. As the material is to be shipped, carefully measured amounts are drawn from a number of different storage bins and are fed into a giant conical blender located on the second floor and fed by overhead hoppers. Here it is tossed and mixed thoroughly in order to assure uniformity for each shipment. Finally, the material passes over a magnetic separator and then goes into an automatic measuring device that fills the Resinox molding powder into steel drums for shipment.

Altogether, from raw material storages to the packaged product, the material in processing and handling makes six full trips from top to bottom of the building, with gravity accounting for approximately 50 percent and air for 35 percent of the total distance travelled. Pumps and conveyors are rarely used.

Along the second floor of the plant is arranged a bank of laboratories for control, testing and color development of Resinox materials. The molding properties of each batch are established on eight presses in the laboratory while impact and flow characteristics are determined accurately and recorded by an electrical apparatus. At one end of the second floor is a row of modern, well-ventilated offices with a separate entrance from the first floor. Research activities on Resinox will be continued in the new research laboratory building at Springfield which was opened during May 1940.

Springfield was chosen as the site of the new plant, among other reasons, because of the excellent shipping facilities that it affords. Three major trunk rail lines serve the city and it is within a short distance of the seaboard for export shipping. Excellent highways radiate to all points, making possible overnight service to a large part of the East. These facilities are further augmented by shipping and handling facilities incorporated in the design of the new building, including two railroad sidings and truck loading platforms.

A powerful air blast removes resin powder from this roller mill pulverizer



Dropping the molten raw resin from the digestors to the cooling floor. After solidification, the mass is broken up and dropped to storage bins

Azeotropic Distillation For Dehydrating Acetic Acid

DONALD F. OTHMER
Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Chem. & Met. INTERPRETATION

Various methods for concentration of acetic acid were described by Professor Othmer in *Chem. & Met.* several years ago. Since then, continued research and experimentation have resulted in better understanding and increased use of the azeotropic distillation method of separating water from acetic acid. In the present article the author reviews some of the work which has been done and describes progressive improvements in the azeotropic system.—*Editors.*

SINCE azeotropic distillation was last discussed in these pages (*Chem. & Met.*, Dec., 1933) there have been numerous advances which make it an even more economical method of separating water from acetic acid.

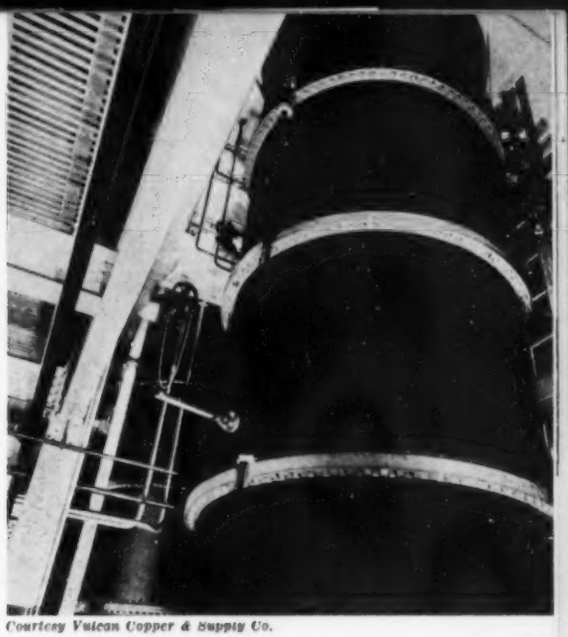
Essentially, the process involves the use of a water-immiscible solvent entrainer having a vapor pressure additive with that of water. This decreases the effective boiling point of the water without greatly affecting the volatility of the acid. Mixed vapors are condensed, the condensate separated, and the entrainer returned as reflux to remove more "sweet water." Thus, the entrainer is a tool which allows the rectifying action to separate liquids which otherwise could not be separated by rectification.

As in most distillations, principal heat cost is that of vaporizing the product and the reflux. The heat of vaporizing the product (water) is almost fixed; thus, the only substantial variable is the amount of heat for vaporizing the entrainer reflux. The reflux ratio is always of prime importance. In this case it is the pounds of entrainer per pound of water, or from the heat standpoint, the latent heat of this amount of entrainer, compared to the latent heat of a pound of water. Since *all* of the entrainer, and *none* of the water is usually refluxed, the ratio is that of the azeotropic mixture (pounds of entrainer per pound of water) and depends on the relative vapor pressures. Vapor pressures of water, of some entrainers, and of the respective azeotropic mixtures (water + entrainer) are shown in Fig. 1. (Method indicated in *Ind. & Eng. Chem.*, **32**, 841, 1940.) Less volatile liquids have a lower azeotropic ratio and hence a lower reflux ratio.

TWO-STEP PROCESSES

Maude (U.S.P. 1,722,532) used benzol as entrainer in a batch operation. The "sweet water" contained some acid (which is thus lost) since benzol has a constant boiling mixture with acetic acid (Fig. 2). Excess benzol was rectified in this C.B.M. in a subsequent step, leaving acetic acid as residue.

Ethylene dichloride (1,804,745) forms no C. B. M. with acetic acid; thus sweet water discharges practically acid-free. An improvement was the use of two continuously-operated columns. Azeotropic dehydration proceeded in the first, discharging a dry mixture of acid and excess entrainer at the base. The second column separates entrainer overhead, from acid as bottoms and is designed from the vapor composition curve (Fig. 2).



Courtesy Vulcan Copper & Supply Co.

Acetic acid distillation
Azeotropic columns

(Besides the usual advantages of continuous operation, a very important additional one appears when handling acetic acid, which is non-corrosive to copper and many copper alloys in the absence of oxygen, while decidedly corrosive in its presence. The frequent shut-downs of a batch unit allow the entry of air; and serious corrosion occurs. Even with continuous operation there is some "breathing" in the condenser and vent system. In some plants, a reservoir of nitrogen gas is connected to all vents, to allow for breathing and to fill the equipment on shut-downs. Thus corrosion is minimized.)

A further innovation, used in all subsequent processes, is the inclusion of a stripping column to remove the trace of entrainer dissolved in the sweet water. This prevents solvent loss and makes operation smooth by keeping constant the amount in the system.

ONE-COLUMN PROCESS EXCESS ENTRAINER

A subsequent patent (1,917,391) also specifying ethylene dichloride, has the azeotropic distillation in the upper part and the acid-entrainer distillation in the lower part of a single column (Fig. 4). The same vaporous heat thus accomplished both operations.

From the point where the aqueous acetic acid is introduced into the column, if we proceed downward, it will be found that the percentage of water decreases. If we proceed upward the percentage of acetic acid contained in the mixture upon each plate will decrease until on the top plate substantially no acid exists. Also, as we proceed upward, the percentage of water in the ethylene dichloride mixture increases. The converse of this is that as we proceed downward from the uppermost plate the proportion of water to ethylene dichloride very markedly decreases until at the lower plates of the column, nothing but ethylene dichloride and acetic acid exist.

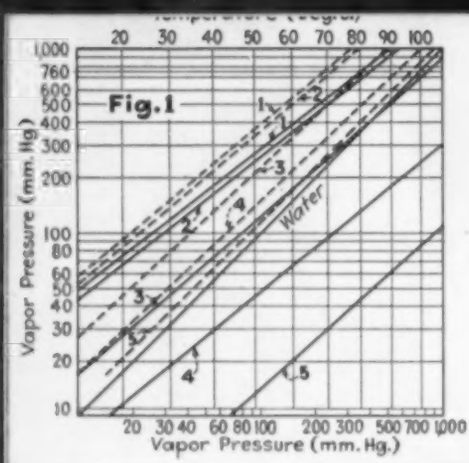


Fig. 1—Vapor pressures of entrainers. Broken lines represent pressures of azeotropic mixtures with water. Key: 1. Benzol; 2. Ethylene dichloride; 3. Propyl acetate; 4. Butyl acetate; 5. Furfural

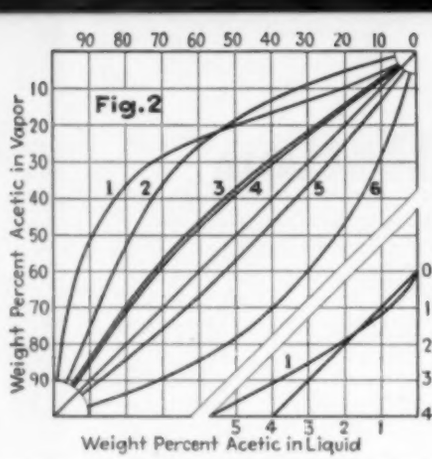


Fig. 2—Vapor composition of entrainers with acetic acid. Weight percent acid plotted in each case. Key: 1. Benzol; 2. Ethylene dichloride; 3. Water; 4. Propyl acetate; 5. Butyl acetate; 6. Furfural

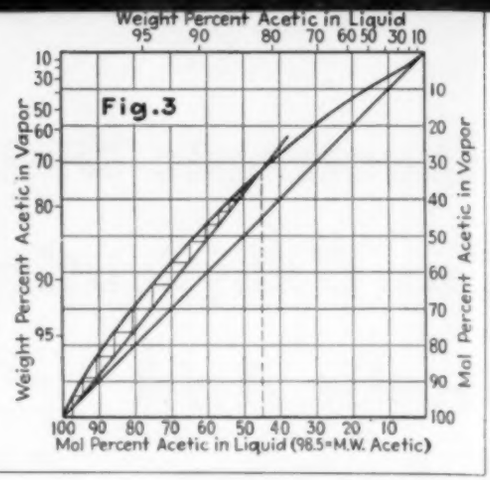

Weight Percent Acetic in Liquid
Fig.3
Weight Percent Acetic in Vapor
Mol Percent Acetic in Vapor
Mol Percent Acetic in Liquid (98.5=M.W. Acetic)

Fig. 3—Equilibrium curve for water and acetic acid, used for calculating the lower part of the column in the "insufficient entrainer" method of dehydrating acetic acid when using butyl acetate

As we proceed downward through the lower plates, the ratio of ethylene dichloride to acetic acid decreases until at the lowermost plate substantially pure acetic acid exists. It will, therefore, be observed that this lower portion performs the same function as the supplemental column required in most processes. (1,917,391.)

This use of one column for both steps simplified operations, reduced heat costs, and cut down equipment requirements—always important because of the high cost of the heavy, corrosion-resistant equipment necessary. A new piece of equipment, a "pre-evaporator," was added for the preliminary removal of non-volatile impurities. The dilute acid was vaporized into the column without increasing total heat consumption. Salts and other non-volatile impurities, such as are met with in dilute acids from acetylation of cellulose and other materials, and from wood distillation (*Chem. & Met.*, **42**, 356, 1935) are thus kept out of the column.

ONE COLUMN PROCESS BALANCED AMOUNT OF ENTRAINER

With the usual assurance of patent writers, the claim was made (1,804,745) that "ethylene dichloride is unique in the extent to which it meets all requirements" for a desirable entrainer. It does not, however, meet the last of the requirements listed. "The ratio of acetic acid in the water to that in said liquid when the two liquids containing acetic acid are in contact (say in superimposed layers), should be low," since in the azeotropic column there are two liquid phases and an extraction operation is proceeding. Thus the entrainer should absorb as much acid as possible from the water phase in order to reduce the acid strength of the sweet water. The same acid strength in sweet water may thus result from the lower reflux ratio of a higher boiling entrainer having a better distribution ratio.

Propyl acetate, the next used entrainer (2,028,800) boils at 102 deg. C. and has a distribution ratio 10 to 15 times as good as that of ethylene dichloride. While it is less volatile and hence has a lower reflux ratio and heat consumption, its rectification from acetic acid is more difficult. The vapor composition curve for it and acetic acid (Fig. 2) indicates a separation no easier than the rectification of water from acetic acid. Excess entrainer could thus not be separated in the lower part of the column and the ratio of entrainer to water was therefore maintained at every point in the proportion drawn off overhead in the azeotropic mixture.

The advantage was the use in a continuous system of a higher boiling entrainer, selected to have a good extraction coefficient for acetic acid so that the smaller reflux would suffice to hold the acid down from the top. With entrainers of higher boiling points, losses are less due to much lower vapor pressures and smaller amounts distilled per pound of water.

ONE-COLUMN PROCESS INSUFFICIENT ENTRAINER

The next step following the "excess entrainer" system of ethylene dichloride and the "just the right amount of entrainer" system of propyl acetate, is the "insufficient entrainer" process of Patents No. 2,050,234 and 2,170,834 (developed and now owned by the writer) wherein is described a method for obtaining the advantages of the lower azeotropic ratio and thus lower reflux and heat consumption of entrainers boiling 102–105 deg. C. Sweet water is taken off containing only one part acid in ten thousand. It is impossible to rectify most of these entrainers from acetic acid, as is indicated by the closeness of the vapor composition to the liquid composition of butyl acetate for example, in Fig. 2.

The complete separation of water and acid without the discharge of higher boiling entrainer in the acetic acid may be accomplished by the control of the amount of entrainer in the system, so that it is only in the upper part of the column; and considerable water is present in the acid below the lowest point where the entrainer reaches. This ability to accomplish the dehydration in a column, which according to previous practice would be regarded as insufficiently charged with entrainer, may be explained on the ground that the fraction of water present is removed from the acid in the lower part of the column by the ordinary rectification process and this water, containing considerable acid, is passed up into the azeotropic distillation range in which the water is separated from the accompanying acid. In the usual case, it is not desirable to have more than 10–20 percent water in the acid passing out of that part of the column which has the entrainer present. This maximum amount of water which can be satisfactorily separated by straight rectification in the lower part of the column without the aid of entrainer depends on the water present in the dilute acid fed to the column and also on the latent heat and azeotropic ratio of the entrainer.

It is well known that if less than 25 percent water is present in acetic acid, it may be separated without the expenditure of an excessive amount of heat by ordinary rectification, but the water so removed will contain considerable acid. The heat requirements are excessive, however, when dilute acids are submitted to ordinary rectification, and especially is this the case when it is desired to remove all of the water substantially free of acid.

By using the lower part of an efficient column in continuous operation for ordinary rectification of the last water from the acetic acid, the vapors, containing all of the water and considerable acid, may be passed into the

upper part of the column wherein the water is completely separated in an azeotropic distillation. Acid is allowed to flow back into that part of the column wherein ordinary rectification is proceeding. The liquid flowing from the upper part of the column to the lower, commonly called "reflux wash," is used in this rectification just as that returned from a dephlegmator would be if this rectification were proceeding in a separate column. Actually, the lower part is fractionating from the anhydrous acetic acid, which is discharged in the usual way from the column base, 80 to 90 percent acid (for example) which is passed as vapor across the hypothetical division into that part of the column where the entrainer persists and removes the water from the acid in substantially the usual azeotropic distillation. The same vaporous heat as is used in the upper part of the column to complete the separation by distillation with the entrainer is used in the lower part of the column to remove the final amount of water by straight rectification. This process is the exact reversal of the former method of azeotropic distillation using comparatively low boiling entrainers such as ethylene dichloride (see U. S. Patent No . 1,917,391) wherein the upper part of the column accomplishes the azeotropic distillation and the lower part of the column is used for a straight rectification of an excess of entrainer rather than an excess of water as in this case.

However, the use of the lower part of the column for straight rectification of water from acetic acid in a two-component system enables the use as entrainers of liquids which have boiling points near that of acetic acid, or indeed at the same temperature or above. Such liquids are even more difficult to separate from acetic acid by straight rectification than the water itself and in the older processes were considered quite impossible of utilization. It is from these liquids that the most efficient azeotropic entrainers may be selected and much smaller amounts of liquids having these comparatively high boiling points are required to bring over a unit amount of water. This means that the column will have less vapor to handle and hence a smaller column can be used. A corresponding reduction in the amount of steam will also be possible (2,050,234).

STRAIGHT RECTIFICATION INSUFFICIENT ENTRAINER

The lower part of the column is calculated from Fig. 3 in the usual way (McCabe-Thiele). At a higher point, where butyl acetate is being used as an entrainer, is fed saturated vapor of 6.64 mole percent (28 wt. percent) acid. A calculated molecular weight of 98.5 for acetic acid is used to give equal molecular heats of vaporization, necessary due to vapor phase association. The reflux wash corresponds to that from the decanter to the top plate and may be assumed to be the same as the azeotropic ratio, in moles. This amount is used to calculate the slope of the operating line of Fig. 3. It will be seen that only 12 theoretical plates and the base heater are required to give an acid of 50 mole percent (85 wt. percent) in the liquid on the top plate of this lower section which discharges 99.5 percent (wt.) to the still pot. The heads product of this lower column section is seen to be a vapor containing 36.5 mole percent (76 wt. percent) acid; and this passes to the next plate above, on which is assumed to be some amount of butyl acetate. The presence of entrainer disrupts the method of calculation but improves the separation of water and acid. The vaporous heat from the water-exhausting section is, of course, immediately available and sufficient for accomplishing the azeotropic separation.

It is obvious that ample reflux wash to exhaust the water is available. By carrying the steps up farther it is possible to dehydrate a slightly more dilute acid than the 50 mole percent on the top plate of this section. The most dilute acid (with an infinite number of plates) is that indicated by the intersection of the operating line with the equilibrium line at 45 mole percent (82 wt. percent) acid. In other words, even in a column having an infinite number of plates for this acid-water rectification, there has to be sufficient butyl acetate entrainer to penetrate down in the column to the plate just above this limiting concentration.

If more entrainer is added, it will occupy plates which are indicated in Fig. 3, operating by straight rectification. Since the addition of entrainer tremendously increases the relative volatility of water (while in this case actually decreasing that of the acetic acid) the acid concentration at the top of the straight rectifying section is increased much more by the taking over of a plate by entrainer than if the plate was left as part of the straight rectification section. In practice, enough entrainer would be added to charge all but the lowest six to ten actual plates, merely allowing sufficient plates without entrainer to insure a safe barrier for preventing the entrainer from reaching the base heater. It is not difficult to control the amount of entrainer added because a large amount, compared to that added from time to time to replace minor mechanical losses, is necessary to cause it to charge any one plate and progress down to the next.

Thermometers are placed every six to eight plates, or even more closely in that part where the azeotropic section ends and the straight rectification section begins. A relatively large temperature difference between adjacent thermometers indicates the entrainer is increasing the spread of the effective boiling points of water and acid while a small difference indicates that water is being separated by straight rectification alone. If so much entrainer is added that the water is entirely displaced, the boiling point at the base goes somewhat above that of acetic acid.

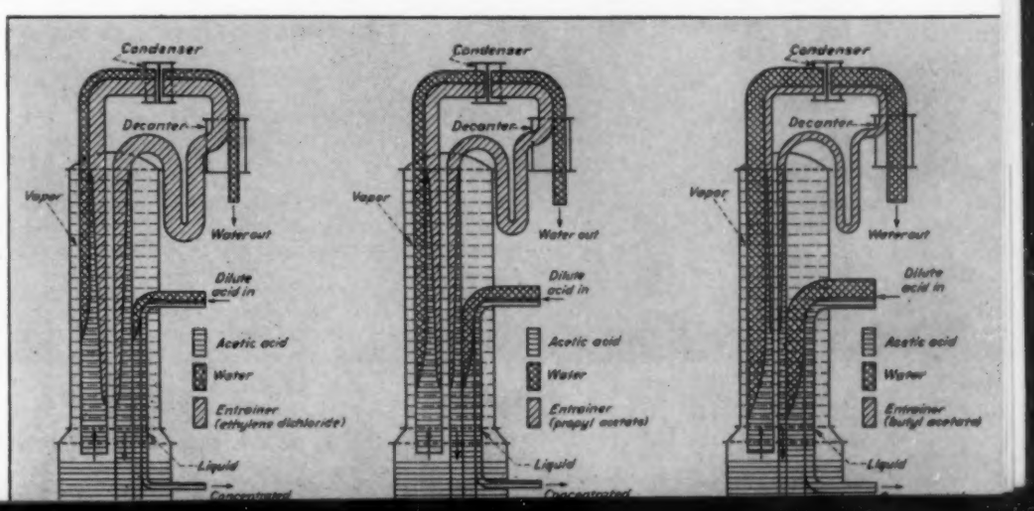
An excess of entrainer may be used in starting the system, the base heater also being charged with dilute acid. As dehydration proceeds, excess entrainer may be withdrawn from the decanter before all water is removed from the base heater and the lower part of the column. Only minute evaporation losses require makeup of entrainer. A unit having a capacity of 150,000 pounds of water removed per day might require an initial charge of about 600 gal. of entrainer, depending on the design of the several parts, and the make-up would not be over a gallon or two a day. The control is not difficult and men who have never seen a distillation column have been trained in a very short time to operate the plant.

COMPARISON OF THREE ONE-COLUMN PROCESSES

A comparison of the operation of the same column using different entrainers with a liquid feed of the same strength has been made (2,050,234) and is diagrammed in Fig. 4. The entrainers are assumed to be completely insoluble in water, molal latent heats are assumed equivalent, reflux and feed liquid are assumed to be at the respective temperatures of the column at their points of introduction, and other minor assumptions customarily made in distilling calculations are used. Widths of the bands of vapor and liquid are made approximately proportional to the number of moles of each component present at each point, to give directly comparable vapor volumes.

Using ethylene dichloride as above

Fig. 4—Comparison of the operation of the same column using entrainers with different boiling points in a liquid feed of 33 1/3 mole percent acetic acid. Widths of bands of vapor and liquid are approximately proportional to the number of moles of each component present at any point



described, enough entrainer is added to go almost to the bottom of the column. The point of disappearance of the water is above that of the entrainer and the straight rectification of entrainer from acid is accomplished between this point and the point where entrainer disappears from acid passing down the column.

Using propyl acetate, the amount of entrainer is so balanced that both water and entrainer are removed simultaneously from acetic acid in their azeotropic mixture at some point below the feed point and above the bottom.

Using butyl acetate, there is so little entrainer charged to the system that it penetrates only to a point some distance above the point where the last of the water is removed from acid passing down the column.

The capacity of the column, of course, depends upon the ratio of entrainer to water in the azeotropic mixture. The figures are drawn with the same total width of vapor bands; i.e., the moles or volumes of vapor are assumed to be the same, as they must be if the same column is used at its full capacity each time. The ratio of water to entrainer in these vapor mixtures leaving the column differs greatly and increased amounts of feed may be handled when using entrainers with progressively higher boiling points. The theoretical amount of feed which may be handled on the basis of 100 for ethylene dichloride is 145 for propyl acetate and 220 for butyl acetate. The actual ratio is almost the same and indicates a very important difference in the size of the expensive equipment required for this work when using higher boiling entrainers. The comparative heat costs per pound of acid produced are also indicated by the band widths.

Summary of Operating Data for the Three Systems

Entrainer used	Ethylene Dichloride	Propyl Acetate	Butyl Acetate
Entrainer, lb. per lb. water in azeotropic mixture	11.3	6.3	2.57
Azeotropic temperature, deg. F.	138	179	195
Latent heat entrainer, B.t.u. per lb. water removed	1,574	911	341
Latent heat entrainer plus water, B. t. u. per lb. water removed	2,576	1,901	1,319
Steam, lb. per lb. water removed	2.66	1.96	1.36
Steam, lb. per lb. acetic acid from 6.25 % solution	39.9	29.4	20.4

The solubility of water in solvent causes a return to the column of a small amount of water which must be again distilled out, requiring more heat. In practice, due to the various losses and recycling of water at the top, the steam cost will be above the theoretical amount; but with insulated equipment for the dehydration alone, it will approximate 1.75 lb. of steam per lb. of water removed, and will not be greatly affected by the strength of the acid feed. Over-all heat costs, including the stripping of water, final distillation of the anhydrous acid, etc., approximate two lb. of steam per lb. of water removed.

The use of a vapor feed instead of a liquid feed does not affect heat requirements since the vaporous heat is immediately available above the feed plate and heat which otherwise would be supplied to the column base is supplied in the pre-evaporator. The latent heat of water in the vaporous feed goes out in the azeotropic mixture. That of the acetic is small and may be neglected and the additional vaporous heat supplied to the condenser is that of the entrainer. Thus the heat supplied by the base heater of the main column is equal to that required to vaporize the entrainer in the azeotropic mixture. Since the vapor volume above the feed plate includes that of the feed as well as that due to the boil-up from the base heater, the upper part of the column must be larger in diameter.

If the gas laws, the theory of additive vapor pressures, and entirely immiscible substances are assumed, the azeotropic vapor volume at atmospheric pressure is equal to that of either substance itself at the azeotropic temperature and the partial pressure exerted by the single liquid at the azeotropic temperature. Thus, the azeotropic vapor volume containing one lb. water is to be found in the specific volume data of the steam tables at the given azeotropic temperature. Comparing the use of ethylene dichloride and the use of butyl acetate, the specific volume of steam is 37 cu. ft. per lb. at the temperature of the butyl acetate azeotrope, and 81 cu. ft. at the temperature of the ethylene dichloride azeotrope. The ratio of the cross-sectional area of the azeotropic column for equivalent capacity with the two entrainers is, therefore, inversely proportional to these values or about 2.2 times as great for ethylene dichloride.

TEMPERATURE OF DECANTATION

The decanter may be at any temperature from the boiling point of the azeotropic mixture, down to just above that of the cooling water available. Minimum mutual solubilities of entrainer and water are desired and solubilities vary with temperature, often in opposite directions. It is, therefore, necessary to determine the best temperature for decantation by balancing the effect of the respective changes of solubility with temperature.

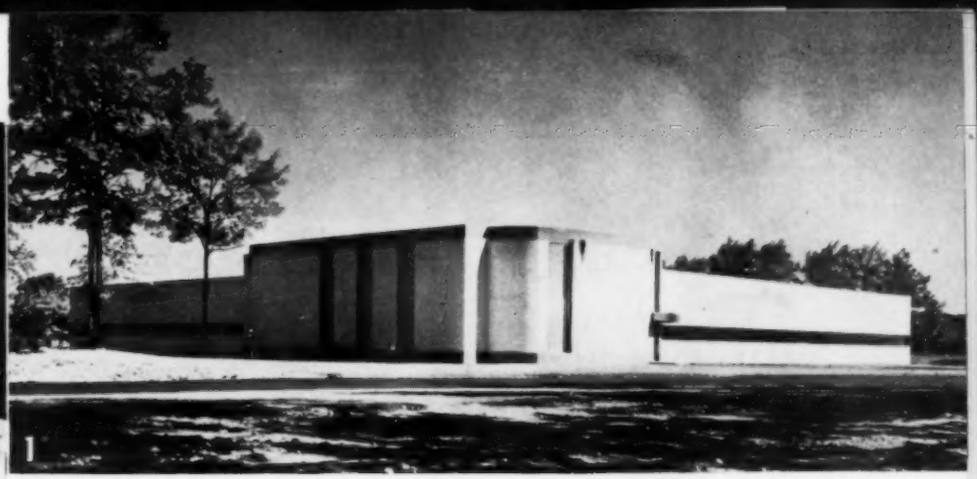
A further consideration is the reheating of the two liquid layers back to the temperatures (the same) at the tops of the two columns, in order to minimize heat requirements; and in one case (*Chem. & Met.*, **42**, 356, 1935) they were pumped through separate passes of the main condenser. With this additional pumping and heat interchanging equipment, advantage could be taken of the optimum decanting temperature. If a simple gravity flow is used, the liquids flow from condenser to decanter, then pass to the tops of the azeotropic and stripper columns. Minimum heat cost will be found by evaluating at various assumed temperatures: (a) respective solubilities; (b) heat requirements for again azeotropically distilling water dissolved in the entrainer layer and returned to the main column, and entrainer dissolved in the water layer and passed to the stripper; and (c) heat requirements to bring both layers from the decantation temperature to the azeotropic temperature.

Capacity is affected in two ways by a change in the decantation temperature: (1) increased solubility of water in entrainer returns more water to the column which reduces correspondingly the amount of water which can be fed to the system; and (2) lowered temperature of decantation requires reheating, condenses vapors of the azeotropic composition to supply this heat, and thus prevents water in the vapors condensed from passing off. The capacity of the stripper is similarly affected and the respective capacities of the two columns at different decantation or reflux temperatures may be calculated to determine the optimum temperature. The maximum capacity (or minimum size) will not necessarily come at the same temperature for the two columns, nor at the temperature for minimum heat consumption, so that equipment sizes or cost and steam requirements will have to be balanced. These calculations, while tedious, are worth while on large installations.

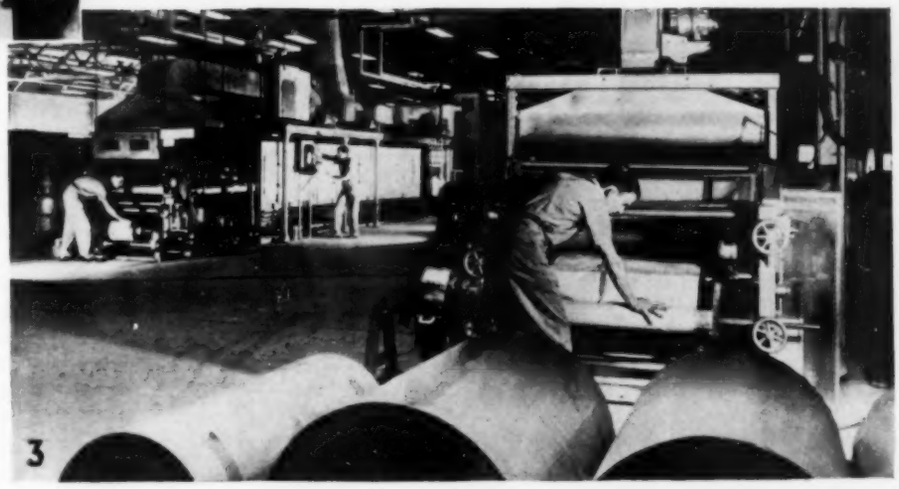
OTHER SYSTEMS

A further step in the selection of higher boiling entrainers in order to minimize the amount of entrainer in the azeotropic ratio (2,123,348) uses furfural which has a volatility so low that there is not enough reflux to prevent acid leaving in the sweet water and more furfural must be added as "reflux" wash to hold down the acid. Excess discharges at the base with the dry acid and is separated therefrom at the base of a second column for re-use, as "reflux." Simultaneously, again, extraction and distillation are used; but the total heat costs are no less than in the "insufficient entrainer" process. Many other patents have been granted on every conceivable variation of the azeotropic procedure as applied to the physical properties of acetic acid, water, and numerous different entrainers. Only a few of the simple methods have been reviewed here and the others involve greater complications of equipment and methods of operation.

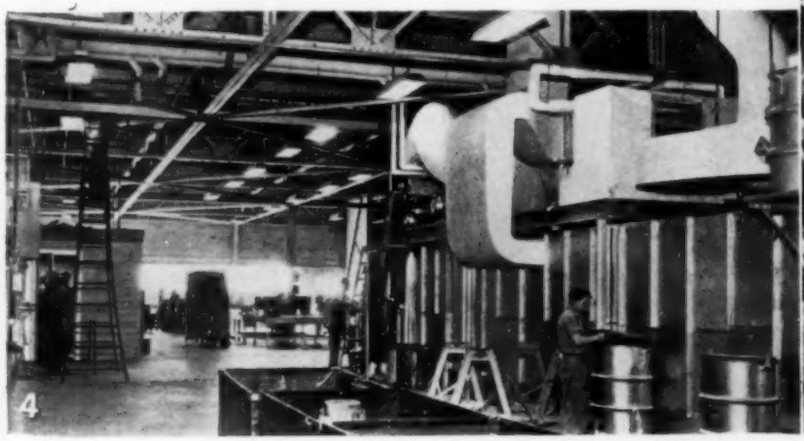
Very recent developments of this art of azeotropic concentration of acetic acid, however, indicate that steam costs may be reduced to a small fraction of the best indicated herein (much lower than by any previously suggested process) and equipment through-put may be greatly increased.



Modern Plant Opened at New Brunswick by Industrial Tape Corp.



Latest wrinkles in plant construction are evident in the new factory dedicated in May by the Industrial Tape Corp., Johnson & Johnson subsidiary, near New Brunswick, N. J. The nearly square building, of 58,456 sq. ft. floor area (Fig. 1), employs hollow tile walls, continuous sash, a flat wood roof, fluorescent lighting, and other modern features. The process consists in applying a variety of adhesives to backing materials such as cloth, paper, cellophane and metal foil, the coated material then being slit and wound on a core to a suitable diameter package, for use in masking and in making many different products, such as parachutes and gas masks. In the adhesive room (2), where there are numerous mixers for rubber-base and other adhesives, a mass is mixed to suitable consistency with solvent. This is then applied by doctor blade to the backing, which enters the dryer (3), (4) where the solvent is vaporized, for recovery in one of two activated carbon adsorbers. The rolls of coated material produced by the process are transferred to high-speed slitters (5) for cutting to width and rewinding.



Safe Practice in the Manufacture of Commercial Detonators

GUY F. ROLLAND *Atlas Powder Co., Tamaqua, Pa.*

Chem. & Met. INTERPRETATION

Among the developments in commercial explosives most important from the safety angle is the use of hexanitromannite in detonators. The plant of the Atlas Powder Co. at Tamaqua, Pa., where hexanitromannite detonators are manufactured, has had an excellent safety record as a result of a well-planned program of safe practice, a few features of which are described herewith. —*Editors.*

NITROMANNITE or hexanitromannite, developed commercially about four years ago by the Atlas Powder Co., possesses considerable resistance to detonation by friction or impact as compared with mercury fulminate when used as a primer or initiating charge in detonators. Hence it is considerably safer to manufacture and handle than the older type detonators. Atlas Powder Co., however, has relaxed none of its safety precautions in manufacturing hexanitromannite, and safety measures have therefore become more effective.

In addition to safety precautions, the Atlas plant at Tamaqua adheres strictly to an elaborate program for the general health and welfare of all employees. A registered nurse is constantly at the plant during working hours and a physician spends some time each day in making periodic physical examinations. Modern facilities, such as hot and cold showers, wash bowls, sanitary lunch rooms and recreation centers, provide a maximum of comfort and protection.

Nitromannite is made by nitration of synthetic mannite. The nitration product is run into drowning tanks, and thence to filters where it is washed free of acid, after which it is processed into a suitable physical form. The normal crystalline form is long needles, but for use in detonators these are reworked into pelleted clusters. Nitromannite is the principal ingredient of "Manasite" detonators manufactured by the Atlas Powder Co. at Tamaqua, Pa.

An important safety and health-protective measure taken by Atlas in the manufacture of "Manasite" detonators is the rule that all employees handling dusty powders wear respirators and take daily showers. In addition, the many ventilating shafts along the roof of the various buildings may be noted.

Because of certain undesirable characteristics of fulminate, including its susceptibility to moisture and high temperature; its sensitiveness to impact and friction; and unstable mercury prices, fulminate manufacture has been sharply curtailed since development of hexanitromannite. However, when fulminate is manufactured, a battery of glass flasks is employed in which mercury, nitric acid and alcohol react. The gaseous by-products, such as nitrites, are eliminated by means of acid-resisting ventilating ducts and are condensed outside the building. In the manufacture of "Manasite" det-

Workman, protected from dust, operating a vibrating screen for tetryl

Plant of Atlas Powder Co. for making blasting supplies at Tamaqua, Pa.

onators, modern dry-houses are used for uniform drying of all detonator ingredients. Tetryl, the other main ingredient besides hexanitromannite, is screened on a hand-operated screen where the operator is fully protected from dust by a respirator and special uniform which is laundered by the company.

Flash powder for the electric match head is manufactured and ultimately prepared for use by drying and screening, after which it is mixed with lacquer. The match heads are dipped under forced draft hood which removes the solvent vapors and are then dried in hooded ovens under forced draft. All match heads are tested individually behind protective glass shields for resistance range.

Detonator shells are drawn by a battery of drawing machines from the gilding metal or aluminum stock of flat ribbons which are about 3 in. wide. From these flat strips are first punched cup-like pieces which look like small thimbles. These are then annealed and drawn into shells after which the explosive charge is compressed into the detonator shells by a mechanical press in which individual pins operate against an hydraulic head. All charging and pressing operations are adequately protected against the hazards of explosions.

Leg wires used in electric detonators are folded and cut to the required length on special machines. The electric match head attached to the leg wires is next sealed in an insulating tube with sulfur. All sulfur melting pots are hooded to remove objectionable fumes. The match assembly is then inserted into the loaded detonator shell and sealed by machine which injects a measured amount of water-proofing compound into each detonator. This operation is completely hooded for removal of vapors and odors from the molten sealing compound. Leg wires and matches are inserted into the frames in one of the main conveyor lines, practically all the assembly operations being carried out by machine. The completed detonators are tested for electrical circuit and then the bare leg wire ends are protected against stray currents by metallic shunts.

Tubes to retain the accordion fold package are also manufactured at the the plant and the completed detonator unit is carried to the pack house on a conveyor line. Almost the entire production of electric detonators is put out in the accordion fold package, as this form offers a greater degree of safety and convenience in handling.

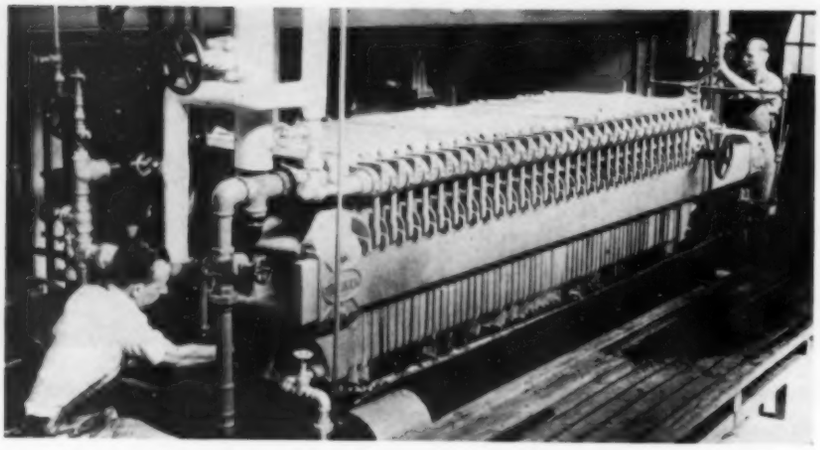
Delay electric detonators are similar to electric detonators except that a time fuse is inserted between the electric match and the explosive charge. This time or delay fuse is charged and consolidated by a hydraulic press and as many as 14 delay periods are available.

Control testing of detonators on lead plates requires adequate and safe equipment. Various protective and safety features are used in the testing operation. These include a heavy steel firing chamber (ventilated by compressed air), a safety firing switch (held open by a strong spring) and a spot light and mirror for observation of conditions from a safe distance and position.

Battery of machines for winding wires into a springy fold to prevent tangling and snarling on blasting jobs

"Balloons" or reaction flasks wherein mercury, nitric acid, and alcohol react to form fulminate of mercury

Loading nitromannite into copper shells, which takes place behind a reinforced concrete wall and is remote controlled by use of a mirror-periscope



Vinyon Now Entering Varied Filter Applications

WILLIAM G. LUTTGE
American Viscose Corp., New York, N. Y.

Chem. & Met. INTERPRETATION

Vinyon, the vinyl polymer yarn developed by Carbide & Carbon Chemicals Corp. and American Viscose Corp., is now available in a considerable number of filter cloth types, woven by Wellington Sears Co. Owing to its high degree of acid and alkali resistance, the material has entered into numerous filter applications.—*Editors.*

When Vinyon vinyl polymer yarns were introduced in November 1939, their high degree of resistance to acids and alkalis made it evident that they would enter into numerous industrial applications, particularly as filter fabrics for the chemical industries. The truth of these predictions has now been proven. Vinyon filter fabrics are being used to an increasing extent wherever strongly acid or alkaline solutions must be filtered. In some cases, their substitution for slower, more costly methods has resulted in greatly improved filtration. In other cases Vinyon cloths have shown their value not only in longer cloth life, but also in improving continuity of operation. This last is especially true in the case of continuous filters where opening to replace the cloth means considerable lost time and production.

Among successful applications of Vinyon cloths may be mentioned filtration of finely divided particles from strong sulphuric acid solution in the production of titanium dioxide. Despite severe acid attack on previous cloths, Vinyon is reported to be lasting indefinitely. Many dyestuffs are produced in strong acid solution and Vinyon is being used successfully. In the filtration of gypsum from phosphoric acid in the strong acid process of making the latter material, Vinyon is working out well. The versatility of filter fabrics of this type is being demonstrated in the manufacture of pharmaceuticals where a wide variety of acids and alkalis must be resisted, making desirable the use of as universal a filter cloth as possible.

Considerable success in employment of Vinyon cloths has been encountered in removing solid particles from concentrated sodium hydroxide solutions. The same is true of filtrations for the reconditioning of acid electroplating electrolytes. Paper mills and laundry operators are using Vinyon cloths successfully against the oxidizing action of hypochlorite solutions, where cotton and asbestos cloths previously proved unsatisfactory.

An interesting application of Vinyon cloths is in the removal of finely divided particles of charcoal used as an adsorbent in hydrochloric acid solutions. Clays which must be filtered under highly acid conditions serve as another good example of a Vinyon application where direct savings and reduction in filtering time have been found possible.

Except for a few little-used substances, such as certain ketones, esters, amines and lower aromatic hydrocarbons, Vinyon is immune to chemical attack, even by aqua regia and hydrofluoric acids. So far, aside from the above-mentioned destructive chemicals, the only deterioration noted in Vinyon filter cloths is due to mechanical wear, provided the temperature is not too high. Vinyon fibers are thermoplastic in nature. At temperatures above 65 deg. C., Vinyon begins to shrink and at higher temperatures it softens, loses strength, and finally tends to weld to other filaments, forming a solid mass. For this reason, Vinyon cloth users are generally cautioned to employ them only in processes below this temperature.

Being woven from continuous filament yarns, Vinyon filter cloths are smooth in comparison with natural fiber cloths and filtered material seldom clings tightly. Owing to ease of cleaning, it is usually necessary only to brush the fabric to remove the residue. However, a strongly adhering material can generally be removed completely by immersing the cloth in a strong solvent.

As produced by Wellington Sears Co., New York, Vinyon fabrics can now be made in all required weights, thicknesses and porosities, to users' specifications. Ducks, such as a tightly woven 13½ oz. per sq.yd. variety, as well as twills and chain cloth constructions, are widely used.

Among acid-resisting applications outside of filter cloths, Vinyon is being used effectively in the form of anode bags in electrolytic operations. Vinyon fabrics are also entering into the field of chemical resistant clothing for workmen, with experiments now being conducted extensively by several chemical concerns on gloves, jackets and cover-alls of this material.

CHEM & MET REPORT ON

Water Treatment For Process Industries

TO CHEMICAL ENGINEERS AND EXECUTIVES

More and more the effect of impurities in water supplies on the process and product is being investigated and determined. As we add to our knowledge of the effects, the tremendous importance of even extremely small amounts of foreign matter becomes evident and forces the lowering of permissable limits of iron, manganese, bacteria, turbidity, and other undesirable constituents in this raw material. And as boiler pressures are increased it is found that purity of water must likewise be increased.

This ever tightening in the specifications for water supplies has been made possible by the progress in the improvement of methods and equipment for purification. The past few years, in particular, have witnessed the development of more rapid and economical methods of water treatment. The editors of Chem. & Met. undertake to present a brief review of these advances and it is hoped that the report will serve to stimulate greater interest in water purification.

CHEMICAL AND METALLURGICAL ENGINEERING
JUNE, 1941

Purer Water Supplies: Methods and Equipment

SUMMARY

Water is an exceedingly important tool in the industries where it is used in a multitude of ways which include processing; steam and power generation; cooling condensers and other water jacketed equipment; general plant purposes and for employees use. While often spoken of as pure, it is never that as this term, as commonly used, simply designates its suitability for drinking purposes. Instead, all natural water supplies contain impurities and these impurities often have a profound and far reaching effect on the products being made and on the manufacturing costs of producing them. While certain industries have done a considerable amount of research work on the effects of water impurities and have established tolerances for certain uses, much yet remains to be done. In this respect, water purification has kept a step ahead and most waters now can be treated so as to render them suitable for practically any purpose. This article describes briefly the impurities in water, some of their effects, certain tolerances and the methods of treatment that may be employed to overcome these difficulties.

THE NATIONAL EMERGENCY PROGRAM is arousing interest in substitutes for aluminum, nickel, neoprene and many other materials that are becoming impossible or at best difficult to obtain. But fortunately industry is not faced with the necessity of finding a substitute for water, unquestionably the most important of all materials used in the process industries. Water is required in great volume for processing, for air washings and cooling purposes, to take care of the power plant and process steam requirements, to provide fire protection for the plant, drinking water for the employees and for numerous other purposes.

INDUSTRIAL USES

Some idea of its importance can be had from the volumes actually consumed by several of the industries in the group.

The pulp and paper industry requires in the neighborhood of 150,000 gal. of water per ton of pulp. If this figure was multiplied by the yearly or even daily production the result would be tremendous. The volume of water to be treated varies with the type of pulp and paper being produced. Newsprint and board mills which, are operating on quite clear, low hardness water supplies often do not require the treatment of much of the water used. On the other hand bleached pulps are large users, one mill making so-called dissolving pulp for the rayon industry treats 30,000,000 gal. per day to remove hydrogen sulphide and then completely softens about 9,000,000 gal. in producing 160 tons of pulp.

Water conditioning for rayon plants is also quite a large scale undertaking. The viscose division in particular requires vast volumes of water for processing needs, the power plant, condensers, sanitation, and air conditioning of the plant buildings. Between 80 and 100 gal. per lb. of rayon are used.

Sulphur mining operations last year required the treatment of about 22,400,000 gal. of water per day. Much of the 3,000 gal. required per ton of sulphur produced, of course, is used for melting the mineral so that it can be easily brought to the earth's surface.

Plants producing sulphuric acid require about 3 billion gal. of water per year. Nitric and acetic acids have water requirements in comparable range. Lime-caustic soda production requires more than 1 billion gal. per year. Gasoline production requires approximately 10 billion gal. annually, and soap and glycerine account for 1½ billion gal. a year.

SOURCES OF INDUSTRIAL WATERS

Water supplies are classified as ground waters or surface waters. Ground waters are those which are drawn from shallow wells, deep wells, springs or mines. Surface waters are those obtained from streams, ponds, lakes or reservoirs.

Surface waters are usually softer and freer of mineral matter than ground waters. On the other hand, surface waters usually contain more organic matter and, frequently, very appreciable contents of suspended insoluble matter. These waters are also subject to rapid variations in composition due to the influences of industrial and domestic pollution, surface drainage of the land, and other factors including rain and drought. Ground waters, due to the filtering action of the strata through which they have passed, usually are free from suspended matter and low in color but their dissolved solids content and hardness are usually higher than that of surface waters in the same region.

The soluble mineral matter in water may contain silica, alumina, iron, manganese, calcium, magnesium, sodium, potassium, chlorine, sulphate radical and nitrate radical. The silica may be present in colloidal or true solution. The alumina is usually present as a hydrated oxide. Iron and manganese may be present in well waters as the bicarbonate, in

surface waters in colloidal or organic forms and in acid mine waters as the sulphate. Calcium, magnesium, sodium and potassium may be present as bicarbonates, sulphates, chlorides or nitrates. The gases that may be found in water are oxygen, carbon dioxide, hydrogen sulphide, nitrogen and, occasionally methane.

Water varies widely in different sections of the country in hardness and other impurities. In general, between the Appalachians and the Rockies is the region where the hardest waters are to be found, while the Northeast, Southeast, with the exception of Florida, and Northwest contain abundant supplies of water of fairly low hardness and low mineral content.

SPECIFICATIONS FOR INDUSTRIAL WATERS

The constituents largely determine the value of water for industrial use. For example, in the pulp and paper industry hard waters are a source of trouble in sizing paper. Calcium bicarbonate alkalinity may cause scale formation on deckers, screens, stock chests, bleach tanks, etc. This scale formation may usually be inhibited by reducing the calcium carbonate to about 35 p.p.m. or 2 grains per gal. Suspended matter in water will decrease brightness of the product, clog the wires and felts, and discolor the pulp. Water used in making a high grade product should contain less than 10 p.p.m. of suspended solids. It should contain no more than 10 p.p.m. of color. High-grade products require as low as 0 to 5 p.p.m. A residual chlorine content of 0.3 p.p.m. to overcome the growth of slime bacteria and up to 0.8 p.p.m. are advisable if chloramines are used. Iron causes discoloration of the pulp and paper and should not exceed 0.1 p.p.m. for high grade products. Manganese is very similar to iron because it discolors fiber and is detrimental to the stability of rosin sizes. It should not exceed 0.05 p.p.m. for high grade products. The CO_2 content in water that exceeds 25 p.p.m. may seriously affect the sheet formation on the paper machine. A limit of not over 10 p.p.m. CO_2 is probably desirable. The economical use of fillers, dyes, sizes, etc., may be adversely affected by lack of knowledge and control of the pH of water.

The rayon industry probably leads all others in the severity of its standards for pure water. It demands a water with practically zero hardness, an iron content of less than 0.1 and preferably below 0.05, manganese less than 0.05, and turbidity as close to zero as can be obtained.

Iron, manganese or excessive foreign material creates spots and discoloration in tanning or processing of hides and leather goods; and after the initial washing, liming and dehairing, process water should be free of appreciable hardness which stiffens the leather and precipitates tannin. Undue causticity should be avoided, as it causes overswelling and improper working of the hide.

In the distilling industry, blending and rectifying water is generally of distilled water quality; complete clarity, palatability, and freedom from iron, manganese, or tendency to precipitate are imperative. The mineral content must be sufficiently low so that it does not precipitate in alcoholic solutions.

WATER PURIFICATION AND TREATMENT

It is usually necessary to treat the water supply in order that it may meet the specification of the industry concerned. In certain cases the impurities in the water cause the formation of scale in boilers and other equipment. Oxygen and carbon dioxide result in corrosion. Other impurities bring about priming and foaming in boiler operation. Bacteria, and lining organisms lead to obnoxious odors and other undesirable conditions. Suspended matter and coloring matter obviously cause serious troubles.

There are several generally accepted methods of water purification; namely, plain sedimentation; coagulation and settling; filtration; water softening; iron and manganese removal; and treatment with chlorine. In addition to these, there are special processes and modifications. Very often it is necessary that a combination of these treatments be used in order to obtain desirable results.

SEDIMENTATION

Sedimentation is the original and simplest method of separating suspended impurities from water. The raw water is allowed to stand or move very slowly through natural or artificial reservoirs until such of the suspended impurities as will do so have settled to the bottom, the clear water being drawn off the top. The extent to which the suspended matter has been removed depends upon the length of the detention period, the degree of quiescence obtained, the size of the particles in suspension, and the temperature of the water. The rate of settling increases with the rise of temperature.

The sediment may be removed at intervals through a sludge spider or tile sludge removal system or it may be removed continuously by a mechanical raking system which scrapes and plows the sludge toward a central drain leading to a sludge pump.

COAGULATION

Chemical coagulation and settling may be carried out after sedimentation or, as is usually the case except with exceedingly turbid waters, coagulation and settling is used instead of sedimentation. The coagulants employed are salts of aluminum or iron and these react with either the natural alkalinity of the water or added alkalinity to produce gelatinous hydroxides or complex basic sulphates known as the floc. This gelatinous floc enmeshes and absorbs turbidity and color, forming larger particles which, with their load of impurities, may then be removed by filtration or by settling and filtration.

A number of compounds of aluminum and iron are used as coagulants. Aluminum sulphate commonly called "filter alum" is the one most extensively used for water treatment. Ferrous sulphate, ferric chloride, sodium aluminate, chlorinated copperas and ferric sulphate are others in use. The ferric sulphate has only recently been applied to this purpose. A few other chemicals are used to a limited extent; namely, alum impregnated with activated carbon, mixtures of ferric and aluminum sulphates and potassium and ammonium alums. Clay is also used to some extent as a filter aid in the coagulation of waters high in color but low in dissolved solids and turbidity.

The formation of a hydrous oxide of aluminum or hydrous oxide of iron (ferric) from aluminum sulphate, ferrous sulphate, ferric sulphate, and ferric chloride usually depends upon the presence of an alkali to unite with the sulphate or chloride. Most natural waters contain sufficient bicarbonate alkalinity for the amounts of coagulant added, but frequently it is essential to apply other chemicals to the water. Ferric salts do not require the presence of alkalinity to coagulate a

colored water as they hydrolize in solution sufficiently to produce ferric hydroxide floc at as low a pH value as 4.0 or even 3.0.

Calcium and sodium compounds are used almost exclusively with coagulants when additional alkali over that naturally present in the water is required. Lime, soda ash and caustic soda are the ones most commonly used. Soda has the advantage of not adding hardness to the water.

Among the factors influencing coagulation are: (A) kind of coagulant, (B) quantity of coagulant, (C) amount and character of the suspended matter or color, (D) temperature, (E) hydrogen-ion concentration of the water, and (F) time of mixing and degree of agitation.

CHEMICAL FEEDS

The coagulants or other chemicals must be thoroughly mixed and the addition to the water should be uniform and in proportion to the flow of the water. Two methods are in use for the measurement of the chemicals—solution feed and dry feed. In the case of the first type of feed, chemicals are put in solutions or suspensions of definite strengths so that when a definite amount of a solution is used, the quantity of the chemical applied may be known.

Pot type feeds, which are charged with the solid chemical in lump or crystal form, are limited in practice to the feeding of potassium alum, ammonium alum or sal soda. An orifice plate, interposed in the water main, diverts a small stream of water, proportional to the main flow, through the pot thus dissolving chemical and feeding it in proportion to the flow of water. Pressure solution feeds operate similarly except that the feeding is accomplished by downward displacement of a definite solution of chemical. Aluminum sulphate, soda ash, silicate of soda, iron coagulants, acids and a host of other soluble chemicals may be employed with this type of feed. Pump feeds may also be employed in the feeding of soluble chemicals, the dosage being dependent on the length and frequency of the strokes.

Electrochemical feeds, in which the lowering of a draw-off pipe is regulated by mechanisms electrically connected to various types of water meters may be employed for feeding either chemical solutions or suspensions. In the case of suspensions, agitators are employed to maintain the suspensions at definite concentrations. For solutions, adjustable orifices, operating from tanks under definite heads, maintained by float valves, may also be employed.

Dry feed equipment is often employed where the amounts of chemicals to be handled are very large. Nearly every type of dry feed machine measures volume of chemical instead of weight, which is accurate enough to insure uniform addition of the chemical. In most instances the coagulating chemical, even though fed through a dry feed machine, is dissolved before reaching the principal flow water. Water is generally added just as the chemicals fall from the feeding part of the dry feed machine and the water serves as a means of conveying the chemicals to the point where they go into the water being treated. Every dry feed machine is equipped with devices for adjusting flow of chemicals over a fairly wide range. There are several machines suitable for feeding hydrated and powdered quicklime and others that will feed lump lime. Where quicklime is employed, it must be slaked in a relatively small amount of water before being added to the main body of water being treated.

SETTLING

After coagulation, settling is of value, as, by this means, most of the floc plus its load of entrained or adsorbed impurities may be dropped out before the water passes to the filters. This lowers the load on the filters and greatly increases filter runs. Settling tanks and basins, the former usually of steel or wood construction and usually above ground level and the latter usually of concrete and partly or wholly below ground level, are often employed. Detention periods of this type of equipment are frequently four to six hours in length, the tanks or basins being baffled so that short-circuiting is avoided and the water flows slowly through the equipment.

Controlled mechanical mixing and agitation is a great improvement over the older method of mixing and agitating by flowing over baffles. Mixing is often accomplished by the so-called flash mix in which the chemical and water are rapidly mixed.

Following the mixing, controlled agitation is of great value in producing a large, tough and easily settled floc. The agitation should be a gentle one, as too rapid an agitation tends to break up the floc and make it difficult to settle. The agitation is usually accomplished by means of slowly revolving paddles driven by a motor acting through a reducing gear. This gently rolling agitation increases the probabilities of the smaller particles colliding with each other, thus forming a coarse, tough and easily settled floc. Recirculation of a portion of the sludge is also employed to increase this effect.

Other developments make use of the previously formed sludge by mixing it with the water and filtering the water upwardly through the sludge. In these, detention periods of one hour are employed and reductions in the ground space occupied by the equipment are effected.

The sludge formed by coagulation and settling is removed by various devices. Sludge spiders and tile sludge removal systems connected to quick opening valves are employed for periodic desludging. Continuous desludging is also accomplished by means of slowly moving rakes or plows. Means of continuous desludging often make use of sludge concentrations to increase the density of the sludge before discharging and thus effect savings in waste water.

FILTRATION

Filtration is usually employed for the final clarification of the treated water. Where the amounts of water used are relatively small, or in cases where the turbidity is low, filters are frequently employed directly following coagulation. Where the amounts of water being handled are large, or the degree of clarification required is high, filters are employed following the settling equipment.

Rapid rate filters are employed, and these may be either of the pressure type or of the gravity type. The pressure type of filter is the one that is most widely used in the industries. Gravity type filters are widely employed in filtering municipal water supplies and to a limited extent in the industries. Both operate on the same principles and the results with either type, when correctly operated, are the same.

Pressure filters consist of a closed cylindrical steel shell, either vertically or horizontally disposed, containing a bed of a filter medium, supported by graded layers of coarser material lying over an underdrain or collector system. During filtration water is admitted, under pressure, to the upper part of the filter, passes downwardly through the filter bed and its supporting layers, then through the collector system from which it is discharged, under pres-

sure, to service. The filter rates usually employed are from 2 to 3 g.p.m. per sq. ft. of filter bed area. As the water percolates through the filter bed, its load of floc and entrained impurities is strained out and collects on and in the upper layers of the filter bed. When sufficient material has collected to cause a pressure loss of 4 or 5 lb. per sq. in. the filter unit is cut out of service and backwashed.

Backwashing is accomplished by sending a strong stream of water upwardly through the filter bed and out to the drain. Backwash rates employed are 10 to 15 or more g.p.m. per sq. ft. of filter bed area. This stream of water lifts and semi-suspends the filter medium, thus loosening the bed and removing the collected impurities which are discharged to the drain.

After backwashing, which takes about 10 minutes, the backwash water is cut off and the filter is rewashed to waste for a few minutes by a downward stream of water. The purpose of the rewash is to settle the bed and collect a small amount of floc on the upper layers of the filter medium so that perfect filtration may be obtained. After the rewash, the filter unit is restored to service.

Vertical pressure filters are available in sizes varying from 1 to 10 ft. in diameter. Horizontal filters are made 8 ft. in diameter and are available in sizes varying up to a maximum of 25 ft. in length. Filters are usually operated in batteries of two or more units, so that when one unit is out for backwashing, the other unit or units can carry the full load.

The most commonly employed filter medium is sand, and where this is used, the supporting layers are of graded gravel and coarse sand. Instead of sand, crushed and graded anthracite is frequently employed. In this case, gravel may be used for the supporting layers, or for a non-siliceous bed, coarser grades of anthracite may be employed.

The arrangement of the filter media in the gravity filters is similar to that in the pressure filters and the operations of filtering, backwashing and rewashing are similarly carried out. While pressure filters usually discharge directly into the service line, gravity filters usually discharge into a clear well from which the water is pumped to service.

Developments in design since the early installations have been concerned principally with the strainer and wash water systems, arrangement and depth of gravel, methods of agitating the sand to secure satisfactory washing and means for controlling operation. Combinations of surface washing with the backwashing are among the latest developments. So also are the use of multi port valves instead of the older valve nest arrangements and fully automatic operation secured with a motor driven main valve or pilot valve connected to hydraulically operated valves on the filter.

SOFTENING

Hardness in most industrial water supplies is objectionable for it results in scale whenever the water is warmed or steam is generated. Scale formations occur in steam boilers, water heaters, piping, valves, cooking jackets, and the like. This greatly increases the costs for labor, repairs and replacements. Hard waters also form precipitates when used with some chemicals and thereby trouble the engineer in the rayon, pulp and paper, and other process industries. The necessity for soft water in the industrial plant is so well recognized that it is estimated over 35,000 industrial plants in the United States are now softening their water supplies.

Methods used for softening industrial water supplies are the cold lime-soda process, the hot lime-soda process; the combination lime-zeolite process; the zeolite process and the carbonaceous zeolite process both on the sodium and the hydrogen cycles. They may be arranged in two groups: (1) the chemical processes, and (2) the zeolite processes.

COLD LIME SODA PROCESS

The cold lime or lime-soda process is so-called on account of the chemicals employed in it and because it is carried out at ordinary temperatures thus contrasting it with the hot lime soda process, which is carried out at temperatures near the boiling point of water. In this process, the chemical—hydrated lime or hydrated lime and soda ash—are added to the cold water and the precipitates formed are removed by settling or by settling and filtration.

Lime is used (1) to remove carbon dioxide, (2) to change the bicarbonates to carbonates, (3) to change magnesium compounds to the hydroxide, and (4) to react with soda ash to form caustic soda. The soda ash is used to change the non-carbonate hardness to the carbonates. In addition a coagulant, usually sulphate of alumina, is frequently employed to aid in settling the precipitates. The precipitates formed consist of calcium carbonate or of calcium carbonate and magnesium hydroxide. The cold lime soda process may be carried out either by the intermittent or continuous process.

The principal advantage of the continuous lime-soda softener is that it occupies less space for a given capacity. In this process, the water as it is slowly passed through a settling tank or basin is dosed with chemicals, agitated and settled. The essential elements are (a) chemical feeders which feed the chemicals in proportion to the flow of water entering the (b) settling tank or basin in which mixing is accomplished in one section by baffles or by mechanically operated agitators and settling is accomplished in another section by employing flow rates low enough so as to permit separation of the precipitates and (c) sand filters through which the water is passed before being delivered to service.

These settling tanks are designed to furnish a detention period of four to eight or more hours. In spite of these long detention periods, the chemical reactions are not completed in the settling tank but continue after leaving it so that deposits are formed on the sand grains in the filters and deposits and incrustations are frequently formed in the distribution system. To reduce some of these difficulties recarbonation, effected by blowing scrubbed flue gas through the treated water, is often practiced.

The recent development of upward-flow precipitation and clarification basins involves two basic principles when used for lime softening. First, the water, treated with chemicals and supersaturated, is brought into intimate contact with previously precipitated sludge particles, thereby exposing the super-saturated water to a tremendous area of previously formed crystal surface, tending to produce, more rapidly and completely, precipitation of the minerals producing hardness in water. Second, clarification is effected by mechanical means bordering upon filtration or straining of the water as it passes through the sludge. Small, newly formed particles of precipitate tend to be entrapped by the larger and heavier sludge particles, resulting in very rapid production of low turbidity effluents.

HOT LIME-SODA PROCESS

The hot lime-soda process differs from the cold process in that it is carried out at temperatures close to the boiling point. The use of this process, therefore, is limited to boiler feed waters or process waters which are to be used hot.

Equipment consists of heater, chemical feeders, settling tank and filters. Due to the high temperatures employed the reactions go to completion much more rapidly than in the cold and also, due to the lower viscosity of hot water, precipitates settle more rapidly. Settling tanks for this process are usually designed for a one-hour detention period.

The settling tank is usually a vertical cylinder with a special conical bottom to facilitate sludge removal, and a rounded top. The heater is mounted on or in the top of the settling tank while the chemical feeders and filters are usually at ground level. The settling tank is also provided with an internal conical or cylindrical drawoff. It may also be equipped with a heater and storage compartment for condensate and may also contain an integral secondary deaerating heater.

Heating is usually accomplished by means of exhaust steam. The incoming water sprays down through the steam in the upper portion of the softener. This heats the water to temperatures close to the boiling point and removes nearly all of its content of dissolved carbon dioxide and air which gases are discharged to the atmosphere through a vent.

Chemicals, pumped from the feeder, enter the heated water as it rains down and precipitates formed settle out as the water flows slowly downward to the drawoff cylinder. Its flow reverses at the downward edge of this drawoff and the water rises through it being discharged from a drawoff pipe to the filters through which it is passed before going to service. Sludge which collects in the conical bottom of the settling tank, is drawn off at intervals by means of a quick-opening sludge valve. Anthracite coal or some other non-siliceous medium is used in the filters.

The residual hardness of the hot-lime soda effluent depends somewhat on the excess of soda ash present. With an excess of some 30 p.p.m. of soda ash, the residual hardness will be less than 25 p.p.m.

SODIUM ZEOLITE PROCESS

Zeolite is a name given to a natural or synthetic compound having base exchange properties. The siliceous zeolites are usually double silicates of sodium and aluminum. When brought into contact with a hard water, the calcium and magnesium change place with the sodium of the zeolite, the sodium forming bi-carbonates and sulphates which are soluble and usually unobjectionable. Zeolites therefore are employed for softening water. At the end of the softening run the zeolite is cleansed by backwashing and then treated with a solution of common salt which removes the hardness from and restores the sodium to the zeolite. After the byproducts—calcium chloride and magnesium chloride—plus excess salt have been thoroughly rinsed out, the zeolite softener is restored to use, ready to soften a further equal quantity of hard water.

This process has come into very wide use for softening domestic and industrial water supplies. Hardness may be practically entirely removed as long as the material is fully active and the plant is properly operated.

An advantage of the zeolite process over the precipitation process is the saving of space for the plant and the absence of sludge to dispose of. Furthermore no carbonation plant is required. Turbid waters should be filtered before softening by zeolite. Besides these features, the principal question is one of cost of operation and this depends largely upon the character of the hardness and price of treatment chemicals.

A zeolite softening unit resembles an ordinary mechanical sand filter with zeolite substituted for sand. The zeolite unit may be the pressure type or the open gravity type. The pressure softener is usually a closed steel cylinder and may be of the vertical or horizontal type. Gravity or open top softeners are usually built of concrete and are rectangular in shape, although some round steel and wood units have been built. The pressure type has one advantage over the open type softener in that it is possible to pump the water to be softened directly from the source of supply through the softener into the distribution system, thus obviating double pumping. Gravity softeners have one advantage in that it is possible to readily observe the condition of the bed.

Natural (greensand) zeolite usually is preferred when the water to be softened contains appreciable quantities of iron, a low content of silica, or is too high or too low in pH value. Synthetic gel type zeolite may be employed with the harder waters low in iron and free from turbidity or color. Smaller units are required and less wash water is needed.

The amount of salt required in the zeolite process is 0.35 to 0.45 lb. salt per 1,000 grains total hardness as $CaCO_3$. Compared with this, the quantity of chemicals required in the lime soda processes for carbonate and sulphate hardness is approximately as follows per 1,000 grains:

	Burnt lime 90%	Soda ash
Free carbon dioxide as CO_2	.22 lb.	
Calcium bicarbonate hardness as $CaCO_3$	.089 lb.	
Calcium non-carbonate hardness as $CaCO_3$	—	.15 lb.
Magnesium bicarbonate hardness as $CaCO_3$	.18 lb.	
Magnesium non-carbonate hardness as $CaCO_3$	.089 lb.	.15 lb.

Operating costs vary greatly according to the composition of the water and the local prices for lime, soda ash, alum and salt, and generalizations concerning operating costs may often be very misleading. Operating costs, therefore, are best compared by figuring each case separately and by taking into account all of the factors involved.

HYDROGEN ZEOLITE PROCESS

Hydrogen zeolites operate on the same basis as the sodium zeolites except that the calcium, magnesium and sodium present in raw waters are removed and an equivalent amount of hydrogen passed to the water instead of the sodium as in the case with sodium zeolite. The effluent of such a unit is free from all metallic ions and contains acids in concentrations corresponding to the original concentrations of the HCO_3, Cl, and SO_4. The H_2CO_3 thus formed readily decomposes into $H_2O + CO_2$ the latter of which is then removed by aeration in a degasifier. The H_2SO_4 and HCl may be neutralized by blending with Na-zeolite softened water or by alkali. Thus, where the raw water is low in chlorides and sulphates, the neutralized hydrogen zeolite effluent approaches distilled water in quality.

The zeolites used in the hydrogen zeolite process are carbonaceous zeolites. The softeners in which they are employed are similar to the siliceous zeolite softeners except that the shells are rubber lined and non-corrodible materials are employed. Regeneration is accomplished by means of dilute sulphuric acid which removes the positive ions—Ca, Ma, Na—and restores hydrogen to the zeolite. After rinsing out the sulphates of these metals plus excess acid, the softener is restored.

The necessity of securing complete external softening and effluents of low total solids content in boiler feed waters may be accomplished by one of the three types of system which have been designed to meet these specifications: that of (a) hot lime soda process (b) cold lime treatment followed by zeolite treatment and (c) carbonaceous zeolites on the hydrogen cycle. These types of plant can, if properly designed and operated, produce water containing low total solids and a minimum amount of hardness.

DE-MINERALIZATION

In the treatment of water with hydrogen zeolites, the bicarbonates of calcium, magnesium and sodium are practically completely removed. If sulphates or chlorides are present, these remain in the treated water as their respective acids. Where the sulphates and chlorides are not objectionable, these may be neutralized, as explained, by mixing the hydrogen zeolite effluent either with the required amount of sodium zeolite softened water or with an alkali.

In cases where sulphates or chlorides are objectionable and where a water approaching distilled water in purity is desired, this may be accomplished by treating the hydrogen zeolite effluent with a material which abstracts the sulphuric and hydrochloric acids. The substances used for this are granular materials which are operated in much the same manner as a zeolite water softener but which are regenerated with soda ash instead of sodium chloride or sulphuric acid.

The train of equipment used, therefore, consists of a hydrogen zeolite water softener unit, followed by an acid removal unit which, in turn, is followed by equipment for removing the carbon dioxide liberated by the action of the hydrogen zeolite on the bicarbonates. In this way, an effluent approaching distilled water in purity may be produced and the costs of operation are mainly the costs of the sulphuric acid used for regenerating the hydrogen zeolite plus the soda ash used for regenerating the acid removing material.

EVAPORATORS

Where it is essential that the make-up water for the boilers be as pure as possible and where the percentage of make-up water is small it is distilled before using. The evaporation supplies a vapor practically free of impurities. When it is used as boiler feed make-up, blowdown and scale formation are virtually eliminated. The low amount of dissolved solid in the water permits the boilers to be operated at high ratings without foaming troubles. Three types of evaporators are in use: (1) submerged-tube, (2) film, and (3) flash.

SILICA REMOVAL

Silica has long been known as a constituent of boiler scales but it is with the advent of the modern high pressure boilers that it has become a very troublesome factor. Silica may form scale in boiler tubes and also at times, due to carryover, on turbine blades. These scales may consist of either silica, calcium silicate or a double silicate, such as analcite. All of these are hard, adherent, difficult to remove and have a low thermal conductivity.

Treatment with phosphate is of value in preventing the formation of calcium silicate scale. Maintenance of sufficient alkalinity to hold the silica in solution, in the absence of calcium, is also of value. Frequently, though, reduction of the silica content of the boiler feed water is necessary.

Silica removal is effected by the adsorptive properties of various metallic oxides or hydroxides. Ferric hydroxide, resulting from the reaction of ferric sulphate with alkalinity, is employed with waters that require coagulation and which do not contain large contents of silica. The latest developments in silica removal have been in the application of magnesia as a silica adsorbent. This, unlike ferric sulphate, does not increase the total solids content of the water and also has a much higher silica adsorbing power than ferric hydroxide. Magnesia is best applied in equipment where thorough agitation and upward filtration through previously formed sludge is obtained.

AERATION

The chief value of aeration is the effect it has in driving out other gases that may be dissolved in the water and which may be deleterious. Water from ponds and reservoirs often possess offensive odors or tastes because of certain dissolved gases and other soluble substances present. Ground waters sometimes contain hydrogen sulphide and carbon dioxide that may be removed by aeration.

In the removal of iron and manganese aeration is an important part of the process. In this case it reduces the carbon dioxide present and supplies necessary oxygen for chemical precipitation of the iron and manganese.

Aeration is effected in various ways: by causing the water to flow over weirs or steps, by dropping it through perforated plates, by forcing it through spray nozzles, by trickling devices such as coke trays or wood slat trays, by special devices which aspirate the air by diffusion through porous plates or perforated pipes, or by still other means. The efficiency depends largely on the degree and time of exposure.

IRON AND MANGANESE REMOVAL

Iron and manganese in the process waters for use in rayon, pulp and paper and other industries is particularly troublesome, principally as unpleasant taste, unsightly stains, deposits and growths of iron or manganese crenothrix. The general methods of removal consist of (1) oxidation and filtration and (2) zeolite treatment. Oxidation is usually effected through aeration and may also be effected by chlorination. The oxidation reactions are interfered with by a number of factors, such as the presence of free carbon dioxide, low total solids and low pH value. Iron present in colloidal or organic forms as in surface waters is usually removed by coagulation and filtration.

The various types of iron and manganese removal plants consist of: (1) aeration followed by filtration or by settling and filtration; (2) aeration, lime feeding, settling, and filtration; (3) oxidation and filtration by manganese zeolite, and (4) removal of iron and manganese by sodium zeolite through base exchange. For the removal of colloidal or organic iron and manganese, coagulation followed by settling and filtration is usually employed.

CORROSION PREVENTION

Surface waters are usually corrosive due to their content of dissolved oxygen. Water from wells and springs frequently contains sufficient free CO_2 to make it quite corrosive. Elimination of CO may be partly accomplished by aeration down to less than 5 p.p.m. Further elimination may be secured by the addition of a small amount of lime, caustic soda or soda ash. A corrosion inhibitant frequently used for the pipe lines in industrial plants is a mixture of caustic soda and sodium silicate which acts by raising the pH value and also by building up a

protective film on the metal surfaces.

In the case of boiler feed waters, deaeration plus the addition of sodium sulphite and the maintenance of a high pH value are advisable. The deaeration effected with an ordinary open heater will generally prevent boiler corrosion in a plant operating at low pressure and without steel tube economizers. In high-pressure plants where any corrosive tendency of the water is aggravated by higher temperatures and where the softened make-up prevents scale deposits, more complete deaeration is required. In such cases the deaerator is used. This heater operates on the principle of bringing steam into immediate contact with the water as it is being broken up into thin films or drops by splashing over trays or being sprayed into the heating chamber.

The deaerator, regardless of the amount of oxygen initially in the feed water, reduces the oxygen in the deaerated water to substantially zero. Simultaneously the heater also removes the free CO_2.

ACTIVATED CARBON

Wider application of the use of activated carbon in removal of taste and odor from water has taken place, especially since the introduction of the powdered form. Applied in granular form, activated carbon required filter beds, but is sometimes the best alternative in year around operation. The powdered carbon is fed to the water being treated at determined rates through dry feed machines equipped with injectors to distribute the resulting water-carbon suspension. It is introduced at one or more stages prior to sand filtration of the water.

Chlorine has now become an essential part of every treatment plant handling surface water, or where the water is likely to be polluted. One theory is that chlorine forms hypochlorous acid with the water, making available active oxygen which is considered the effective sterilization agent. Another theory is that the chlorine itself has a toxic effect upon the bacteria. In general, liquid chlorine is more effective than the same amount of available chlorine from chloride of lime. This would seem to bear out, to some extent, the latter theory.

As drawn from cylinders the chlorine is in the form of a gas which is applied directly to the water supply, or as a chlorine solution formed by mixing with a small quantity of water, the latter method now being more commonly used. When applied as a dry gas it is usually diffused through porous plates or disks in order to provide better combination with the water. When applied as a solution, provision is made in the apparatus for the continuous formation of the solution of chlorine water which in turn is applied to the water to be treated.

Among the other means of treatment of water mention might be made of ultra-violet rays, ozone, ammonia, permanganate of potash, and copper sulphate.

INTERNAL TREATMENT

Internal treatment is the feeding of chemicals into the boiler with the water so that the reactions take place within the boiler. This type of treatment is employed in order to prevent scale and corrosion. The amount of solids precipitating out of solution in a boiler depends largely on the amount of scale-forming compounds introduced in the water.

Internal treatment alone is frequently employed in small plants where the operating conditions are not very severe. In large plants, internal treatment is employed to supplement external treatment, thus precipitating any residual hardness in the water, feed water and counteracting leakage of hard water into the condensate.

Reprints of this 8-page report are available at 25 cents per copy. Address the Editorial Department, Chem. & Met. 330 W. 42nd St., New York, N. Y.

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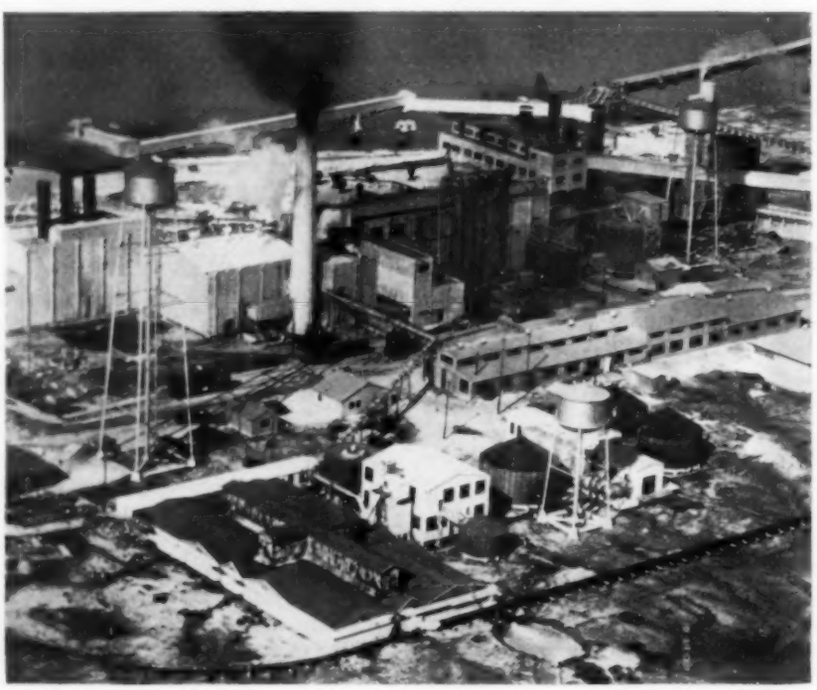
Water treatment plant of a modern pulp mill in the foreground. 30,000,000 g. p. d. treated to remove H_2S and 9,000,000 g. p. d. softened



Machinery, Materials and Products

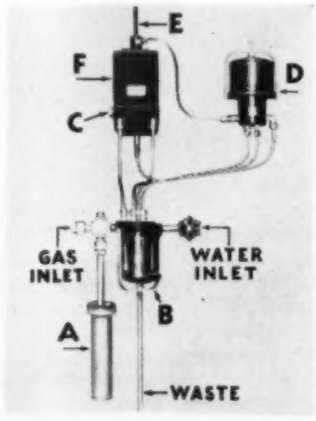
Chem & Met Process Equipment NEWS

Oxygen Recorder

AN INSTRUMENT designed for measuring the oxygen concentration of any gas, and recording this concentration continuously and automatically, has been announced by Cambridge Instrument Co., Grand Central Terminal, New York, N. Y. This instrument differs considerably from this company's dissolved oxygen recorder, described on page 99 of our March 1941 issue. The new instrument is fully electric, requiring no chemicals for operation. Various ranges from 0 to 2 percent oxygen for full scale, to 0 to 100 percent for full scale, may be obtained. Variations in the constituents of the sample gas do not affect accuracy of the determinations, since a differential measurement principle is employed.

As shown in the accompanying illustration, gas is drawn into the instrument by the water aspirator, *B*, any condensate collecting in *A*. Part of the stream serves as a purge, the remainder passing through one side of the thermal conductivity cell *D* by way of a filter, orifice and sample collecting bell. After determination of the thermal conductivity in this sample, the sample passes through a small furnace *F*, containing a heated carbon rod in tube *E*, where the oxygen combines with the carbon to form CO_2. The sample with oxygen now replaced by carbon dioxide then flows back to the other side of the thermal conductivity cell. The difference in conductivity shown by the two cells is then a measure of the oxygen concentration of the original gas.

Oxygen analysis unit



Small Glass Pump

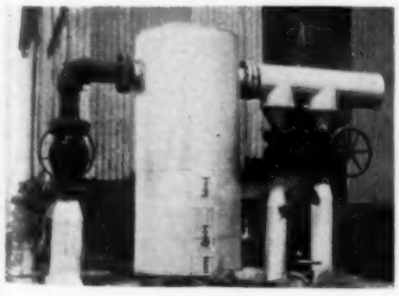
FOR SMALL INSTALLATIONS requiring a pumping capacity up to 10 g.p.m., a new all-glass centrifugal pump of ¾×1 in. size has been announced by the Nash Engineering Co., South Norwalk, Conn. Similar in design to the larger 1½×2 in. glass centrifugal pump previously announced and described on page 528 of our September 1939 issue, the new pump is fabricated of Pyrex glass and is a joint development of Nash and the Corning Glass Works. Like the larger pump, the new small size employs glass for all parts in contact with the liquid pumped, has a spring-loaded safety unloading feature, and a unique mechanical seal replacing the conventional stuffing box. Liquids of any temperature and of any character not harmful to Pyrex glass may be handled in the new pump.

Gas Scrubber

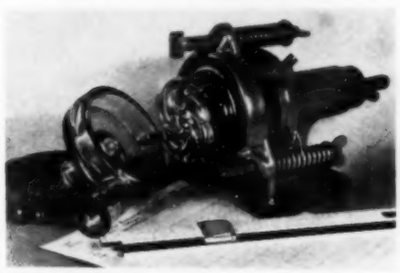
FOR THE CLEANING of steam, air and gas, by separating water, dirt, scale, fog, foam, oil and other contaminations, a scrubber known as the W.K.M. Master scrubber has been developed by W.K.M. Co., Inc., Houston, Tex., and is available in the industrial field from Bradshaw & Co., 530 Fourth Ave., Pittsburgh, Pa. This scrubber is of the receiver type, designed to remove all contaminating substances except those in the vapor phase. It is claimed that satisfactory operation results regardless of the quantity of contamination and that steam passed through such a scrubber, when condensed, will be equal in purity to triple distilled water.

Such scrubbers are being used, according to the agents, in cleaning live steam for all kinds of processing; in purifying exhaust steam for kettles, vulcanizers and similar equipment, and for removing foreign matter from compressed air for glass molding, paint spraying and similar operations. In the smaller sizes, scrubbers are available for use on control boards to purify the air supplied to pneumatic control equipment. The scrubber consists of a vertical cylinder with inlet and outlet connections near the top, containing an entrainment section in which deflection of the gas or vapor stream, together with contraction, expansion and other separating effects, are employed.

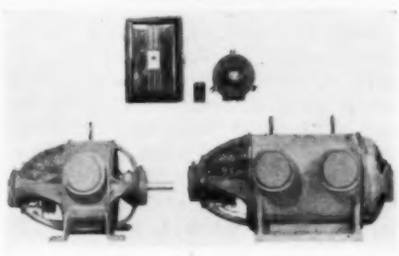
Scrubber operating on exhaust steam



10 g.p.m. Nash-Corning pump



A.c. variable speed drive

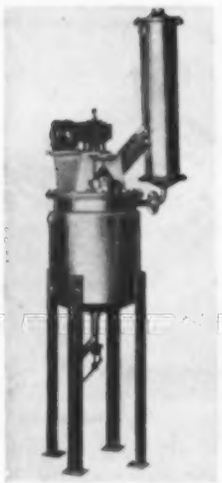


Adjustable A.C. Drive

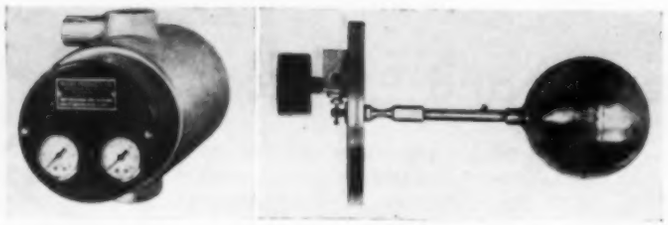
TO PERMIT a wide range of speed adjustments at constant torque, in industrial applications in locations where only a.c. power supply is available, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has introduced a new 10-to-1 adjustable-speed a.c. drive. This is available in ratings from 1 to 15 hp. for two- or three-phase operation on 60 cycle systems from 220 to 550 volts. As compared with the usual system of accomplishing variable speed drive from an a.c. power source by all-electric means, the new system has been considerably simplified. A series circuit is used and the usual exciter is not required.

The new drive has five parts, including the control: (1) a single-unit, motor-generator set, consisting of a squirrel-cage induction motor driving a series d.c. generator which supplies operating voltage for (2) a d.c. series motor coupled to the driven load. In parallel with the generator series field is (3) a rheostat which controls the driving motor speed. Control apparatus consists of (4) an across-the-line starter for the squirrel-cage motor, and (5) a pushbutton station.

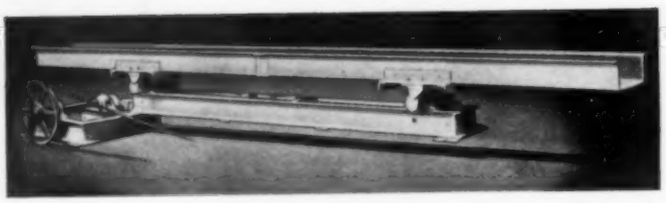
The new drive is stated to be more flexible than a wound-rotor motor and



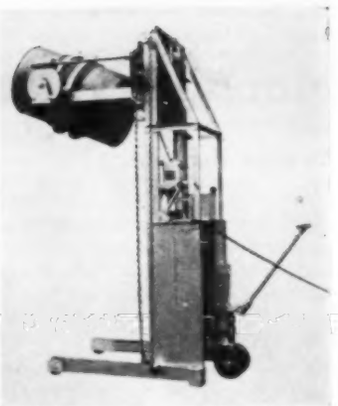
Mixing kettle



New level controller



New vibrating conveyor



Drum-tilting stacker

Swivel-socket floodlight

to be more efficient than the conventional variable-voltage system since exciter rotational losses are eliminated. Except at the highest speeds of the d.c. motor, the unit has an exceptionally flat torque characteristic. If desired, the unit may be equipped with dynamic braking and inching control.

Among numerous types of application suggested by the manufacturers are: conveyors for various purposes, lathe drives for ceramic work, soap-making machinery, feeders, bottling and packaging machines, and paper mill screens.

Solvent Recovery Mixer

SHOWN in an accompanying illustration is a condenser-equipped mixer for viscous materials, recently developed by L. O. Koven & Bro., Inc., Jersey City, N. J. This machine was built especially for the dispersion of a mixture of colors in a volatile medium. However, it is suggested by the manufacturer not only for use in lacquer manufacture, but also in the processing of numerous chemical mixtures, pharmaceutical and cosmetic compounds, paints, organic finishes and particularly where delicate materials, sensitive to over-heating, lose valuable solvents during the heating operation.

The stainless steel mixing kettle is steam jacketed and built for vacuum operation. The agitator is a bottom- and side-scraping paddle, with another mixing paddle on the same shaft above the scraper, set at 45 deg. to create a downward surge in the mix. The stainless steel condenser may be used for recovery of the solvent, for refluxing of evaporated solvent, or for refluxing followed by recovery. To permit quick discharge of highly viscous products, the bottom of the agitator shaft is supported on a tripod giving an ample opening to the quick-opening flush-type plug discharge valve. Through provision of means for easy cleaning, different mixtures may readily be processed in successive batches, according to the manufacturer.

Liquid Level Controller

DEVELOPMENT of a new liquid level controller design which eliminates the need for packing glands, pressure-tight shafts and electrical transmission systems, has been announced by Moore Products Co., 3629 North Lawrence St., Philadelphia, Pa. The instrument is of the float type, and transmits the float motion through the wall of a pressure vessel by means of a flattened flexible member similar to a bourdon tube. A flat lever inside this tube, fastened to the float shaft, connects directly with the air pilot valve, or to a micro-switch in case electrical control is to be used. The mechanism is shown at the right in the accompanying view. At the left, the mechanism is assembled inside a float chamber, with indicating pressure gages for the supply and controlled air pressures. The instrument may also be installed in a standard tee, or through the wall of a pressure vessel.

In operation, a change in the buoyant force on the float flexes the flattened tube and transmits motion to the control means. The sensitivity is such that a change in level of $\frac{1}{2}$ in. of water is said to result in a full 15-lb. change on the transmitted control pressure. With a special float, the equipment is claimed to operate at 5,000 lb. per sq. in. pressure with only a 20 percent reduction in sensitivity. By using a slightly larger weighted float, this control is claimed to have been used successfully for interface level control where the difference in specific gravity of the two liquids is as low as 0.07.

Drum-Dumping Stacker

ELEVATION and dumping of drums, barrels and other liquid and dry material containers is the purpose of a newly improved drum-dumping stacker now being marketed by Lewis Shepard Sales Corp., 245 Walnut St., Watertown, Mass. A feature of the design is that the operator can control the dumping operations from the floor. The drum may be held for as long as desired in any position by the self-locking worm used to control the tilting. Both speed and direction of the tilting are under instant control of the operator.

Vibrating Conveyor

FREE-FLOW is the name given to a new line of vibrating conveyors and feeders recently introduced by Standard Transmission Equipment Co., 416 West 8th St., Los Angeles, Calif. With this equipment, materials may be conveyed in controlled volume either horizontally or up inclines as steep as 15 deg. The action of the conveyor is described as a "lift-throw," with the motion of the trough becoming increasingly horizontal with the progress of each cycle, thus imparting a gentle forward movement to the material which is suspended in the air for most of the cycle. This action is said to minimize wear from abrasion and to transport delicate materials safely.

This equipment is available in sizes having capacities from 198 to 1,800 cu.ft. per hour, using troughs varying in cross section from 4×4 in. to 12×12 in., made in lengths to suit individual requirements. Feeders are similarly constructed except that they are shorter and are provided with a feed hopper. Variable speed drives are available for both feeders and conveyors.

Swivel Floodlight

A NEW Birdseye floodlight designed especially for applications requiring intense illumination for exacting work has been announced by the Birdseye

Lamp Sales Division of Wabash Appliance Corp., 335 Carroll St., Brooklyn, N. Y. The new lamp delivers a concentrated flood of light in a medium beam. It is essentially an incandescent-filament bulb with a lining of pure silver sealed inside to form a reflecting surface. For localized lighting to supplement general illumination, a detachable swivel socket is available to focus the light exactly where needed. It is available in four sizes and four separate voltages from 100 to 300 watts and 110 to 125 volts.

Color Comparator

LOW COST and simple operation are important characteristics of the new Comparascope which is being manufactured and distributed by Graphic Arts Research Corp., 420 Lexington Ave., New York, N. Y. The instrument, which is light in weight, weighing about 6 lb., consists of a 10-in. diameter aluminum sphere supported on a stand. In the bottom is a divided horizontal viewing stage accommodating samples up to 1 in. in thickness. Illumination is provided by light sources placed at each side of the sphere. A revolving seven-aperture eyepiece at the top is provided for viewing the standard and sample on the viewing stage at a fixed angle of 10 deg. to the normal.

The interior of the sphere is coated with a dead white so that there are no shadows or reflections. Hence materials viewed on the stage "flatten out", eliminating glare from the comparison. Seven color filters in the revolving eye-piece permit making the comparison under various simulated light conditions including north daylight and artificial light at two different intensities; also under red, green and blue light.

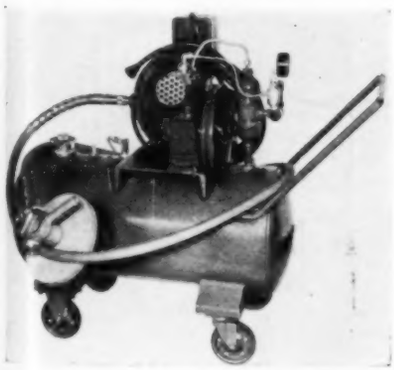
The manufacturers claim that color comparisons can be made with the new instrument by operatives without special skill, in the case of all sorts of color comparisons such as those of paints, papers, plastics, textiles, foods and other solid or semi-solid materials.

New color comparator

Filter Scrubber

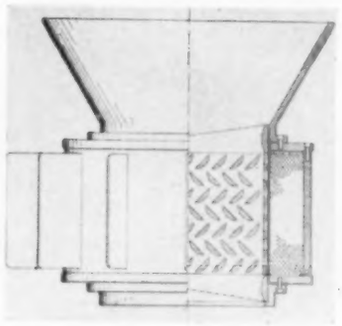
A ROTARY POWER SCRUBBER for cleaning and acid treating the cloths of rotary vacuum filters has been announced by National Electric Manufacturers Co., New York, and is being handled, as agents, by Oliver United Filters, Inc., 33 West 42d St., New York, N. Y. With this new device, it is claimed that one man can scrub and acid-treat an 8×14 ft. drum type filter in 20 to 30 min., including scrubbing and hosing-off. The unit is self-contained, readily portable, easy to operate and can be charged ready for use in a minute's time. It consists of a small tank mounted on casters for the acid or cleanser solution, on top of which is mounted a small motor driving an air compressor and a rotary brush. The brush is driven by means of a flexible shaft, while the cleaning solution is forced by air from the compressor, to the brush, through a tube. A valve at the brush controls the feed rate. The brush is claimed to agitate and spread the solution evenly over the surface of the filter, providing uniform application and preventing loss by spilling or spattering the operator. For cleaning disk type filters, the disks may be removed and placed upon a rack for scrubbing and acid treatment.

Rotary filter scrubber



Boiler water slide comparator

FerroFilter for dry materials



Boiler Water Comparator

DETERMINATION of pH and phosphates in boiler water for the control of corrosion and scale formation is the function of a new slide comparator recently announced by W. H. Taylor & Co., 7300 York Road, Baltimore, Md. The outfit consists of a regular Taylor pH slide comparator with three color standard slides, covering the range from pH 7.2 to 11.6 plus a high and a low phosphate slide working on the pH base; the necessary indicator solutions and reagents; and equipment for phosphate determination. The method of phosphate determination is said to avoid interfering reactions with constituents other than phosphate. Considerable concentrations of silica, iron or sulphites are stated to cause no error. The reagents are claimed to be extremely stable, giving accurate results after storage for more than five years, while all color standards carry an unlimited guarantee against fading.

Dry Magnetic Separator

REMOVAL of iron particles from free-flowing dry granular materials, such as sugar, grain and sand, is the function of a new dry magnetic separator recently developed by S. G. Frantz Co., 161 Grand St., New York, N. Y. The new FerroFilter No. 68 follows the general principles of the screen-type wet FerroFilter manufactured by this company, except that the screening surface is of different construction. There are no moving parts and the machine is readily cleaned by turning off the current. The capacity is stated to be several tons per hour in usual service.

As will be noted from the accompanying illustration, this separator consists of a stack of several iron grids magnetized by a d.c. coil in the casing surrounding the grids. It will be noted that alternate grids have vanes sloping in opposite directions so that material must follow a zigzag course, while magnetic materials are caught at the edges of the vanes. Exclusive of legs, approximate dimensions of the machine are 19 in. in diameter and 15 in. high.

Equipment Briefs

SUBSTANTIAL REDUCTION in rejections of precision molded parts is said to be accomplished by a new control available on the Standard semi-automatic molding presses built by Standard Machinery Co., Mystic, Conn., and available from the Plastics Div. of F. J. Stokes Machine Co., Philadelphia, Pa. The new feature is a slow-closing con-

trol which permits adjusting the final closing of the mold under compression to from one second to 20 minutes, as desired. The closing speed is timed automatically and duplicated each cycle. Through use of the new control, it is claimed that maintenance cost on molds is reduced while less expensive molds can be used. Furthermore, savings in molding material as high as 20 percent are claimed. The control mechanism makes the press automatic in operation, except for actual loading and removal of finished pieces.

NATIONAL 99 is the name of a new fire foam said to be effective with a wide variety of organic solvents such as alcohol, ether, and acetone, offered by National Foam System, Inc., 1632 Sansom St., Philadelphia, Pa. Both Underwriters' Laboratories and Factory Mutual Laboratories have approved the new chemical for use in foam generators. Application of the foam may be made through a hose stream or through direct connection to storage tanks or to the distributor heads in dangerous areas. The manufacturers claim that previously available foam formulas disintegrated in the presence of certain organic solvents.

ALTHOUGH the Trane Co., La Crosse, Wis., has manufactured fans for years which were used in other Trane products, generally speaking, these fans have not in the past been offered separately. This company has now introduced an inclusive range of backward and forward curved blower fans for all heating, cooling and ventilating applications. The forward curved multi-blade types are available in single and double widths, in diameters to 60 in., while the backward curved types are built in diameters to 66 in. Direct-connected units are available.

A NEW high-pressure spiral asbestos packing, particularly intended for use on reciprocating rods and plungers of steam engines, pumps and compressors, has been developed by Greene, Tweed & Co., 101 Park Ave., New York, N. Y. The outer layer is impregnated with a special graphite grease forced into the packing by a hot pressure process. The packing is made of closely woven asbestos cloth with the center block laid up against a flat strip of heat-resisting red rubber. The wear face is firmly bonded to the center. The construction is said to give ruggedness and resilience, with lasting lubrication.

IMPROVEMENTS in its line of spout-type magnetic separators have been announced by the Stearns Magnetic Mfg. Co., Milwaukee, Wis. The magnetic field has been made more powerful, according to tests conducted by insurance company engineers. The coils are now protected by aluminum plates provided with ample louvers for ventilation, but designed to keep out dirt and dust. A simple arrangement now opens the safety gate automatically when current is turned off, closing it with resumption of the current. For alternating current operation, a new type rectifier is provided. Designated as Super Class AA, the new magnet is built in widths from 8 to 20 in., for 110 or 220 volts a.c. or d.c. current.

EASTERN ENGINEERING CO., 45 Fox St., New Haven; Conn., has announced a new midget size centrifugal pump equipped with an explosion-proof motor of 1/12th hp., producing a pressure of 16 lb. per sq. in. and a maximum delivery capacity of 5.7 g.p.m. The motor has been approved for Class I Group D atmospheres. The pump and motor are of the close-coupled type, with pumps available in a variety of corrosion resisting materials of construction.

Barrel Lift

SAFE LIFTING of steel drums and barrels is the purpose of a new barrel lift recently introduced by Falstrom Co., Passaic, N. J. The new device consists of a steel framework mounted on wheels which may be moved up to the barrel and the supporting member clamped to it securely between the flanges. A downward pressure on the handle then lifts the barrel into carrying position. With the handle depressed, the barrel is locked in the elevated position and may then be transported, or tilted for pouring.

Conductivity Controller

AN INSTRUMENT known as the Solu-Bridge Controller is now being offered by Industrial Instruments, Inc., 156 Culver Ave., Jersey City, N. J. This instrument combines the analytical function of the company's Solu-Bridge, which was described on page 708 of our November 1939 issue, with a sensitive vacuum tube relay which controls an external circuit containing a suitable alarm or an electromagnetic valve or other corrective means for bringing the solution to the desired conductivity. The instrument itself is of the electronic type.

The instrument may be remotely connected to one or more conductivity cells. Using the Magic Eye as the indicator, the balancing dial may be rotated to obtain balance, at which point the conductivity reading in percentage, or other desired terms, may be taken off. However, for control purposes, setting the balancing dial at any reading will, when the conductivity reaches this value, automatically operate the relay, either closing or opening the contacts as desired. This relay is capable of handling an external current up to 2 amp. at 110 volts, to actuate any desired kind of alarm or a suitable control valve.

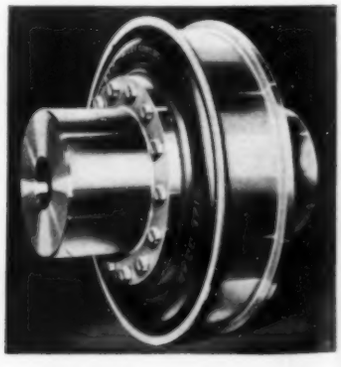
Portable barrel lift

Pneumatic Shaft Coupling

SUPERIOR damping of shock and vibration, plus ability to adjust the degree of flexibility, are important characteristics claimed for the new Airflex coupling developed by the Falk Corp., Milwaukee, Wis. Although the new coupling is available in several variations, the basic design consists of two concentric drums between which is a special resilient rubber gland roughly resembling a pneumatic tire. The gland is permanently bonded on its outer surface to the inside of the outer drum, and on its inner surface to the outside of the inner drum. The gland is inflated to the proper pressure through a standard tire valve, the degree of elasticity of the coupling depending on the air pressure selected. Six styles are available, providing several variations in methods of connecting to driving and driven shafts or machinery. One type incorporates a thrust unit, and another permits disconnection of the two units by deflating the coupling.

Electronic conductivity controller

New Airflex coupling



FACTS YOU NEED TO KNOW ABOUT . . .

Acid Filtration

The lead-constructed rotary-drum vacuum filter represents the ultimate in long life and low operating costs

About ten years ago, Swenson developed the lead type filter for handling acids and other corrosive liquors. This filter represented a marked improvement over existing "acid-resisting" filters and made possible great reductions in maintenance and operating costs.

ADVANTAGES

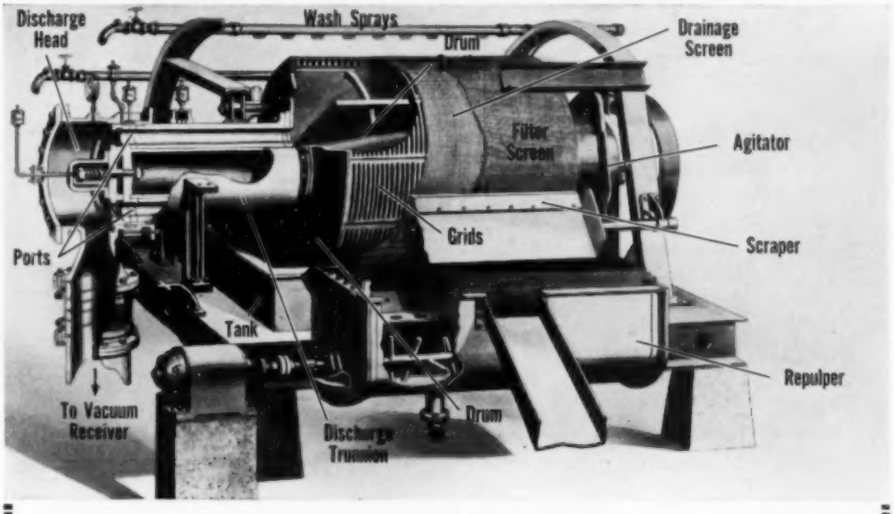
Lead type filters have proved extremely satisfactory in resisting acid attack. Except for actual mechanical erosion, the lead filter will last indefinitely.

The simple mechanical construction of the lead-type filter, with rubber-lined auxiliaries, greatly reduces maintenance and repair. Thus, while this construction is somewhat more expensive than other types, in the long run it has proved considerably more economical.

CONSTRUCTION

The mechanical design of the Swenson lead-type filter is identical with that of the standard Swenson rotary-drum vacuum filter. The main foundation is of heavy sheet lead, as are all other lead parts. Filter screens can be of Monel metal or stainless steel. Perforated rubber filter mediums can also be used. The valve and wear plates are made of S-Monel, acid-resisting bronze, or Illium.

The tubes in the discharge trunnion can be constructed of Pyrex, Illium, nickel, or hard rubber. A few of the external parts, such as the tank, agitator, repulper, vacuum receiver, trap, and interconnecting piping are constructed of rubber-lined steel.



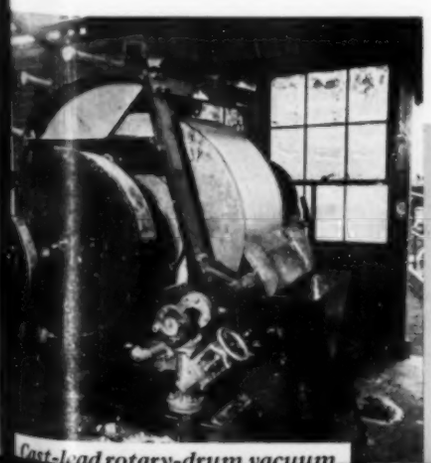
OPERATING PRINCIPLE OF THE SWENSON LEAD ROTARY-DRUM VACUUM FILTER

Feed enters the tank and the solids are held in suspension by an agitator. As the drum rotates through this slurry, liquor is sucked through the filter screen, while the solids remain on the drum surface as a cake. This filter cake passes through the initial drying section, then under sprays of wash water, and then through the final drying section. It is finally removed by a scraper assisted by a light blow-back of air. Dewatered cakes may be discharged direct or to a repulper. The filtrate and air pass into the drum sections, then through ports in the discharge trunnion, thence into the discharge head, and finally into a receiver.

TYPICAL APPLICATIONS

The Swenson lead-type filter has proved remarkably successful for filtering from Glauber's salt, copperas, zinc sulphate, copper sulphate, and other crystalline salts from acid solutions.

SWENSON also offers filters for non-corrosive liquors, including rotary-drum vacuum filters, top-feed filters, and rotating-leaf pressure units. In addition, Swenson manufactures cast-lead type evaporators for the concentration of acids and other corrosive liquors, as well as long-tube vertical, forced-circulation, vertical-tube basket, and horizontal-tube types. Write for bulletins.



Cast-lead rotary-drum vacuum

SWENSON EVAPORATOR COMPANY

Division of Whiting Corporation • *15669 Lathrop Ave., Harvey, Ill.*

SWENSON

LEAD FILTERS

EVAPORATORS • CRYSTALLIZERS

RUBBER RECLAIMING

A *Chem & Met* FLOW SHEET

SO MUCH IS BEING HEARD at this time about a possible shortage of crude rubber in case of war that reclaimed rubber has gained a vastly more important position. The reclaimed material can be used in almost every rubber product. Among its main uses are mechanical goods such as gaskets, packing, valve seats, and all kinds of hose, automobile attachments such as pedal pads, running boards, mats and windshield wipers. It is used extensively in hard rubber products.

The reclaiming of scrap rubber for re-use involves many chemical engineering operations. The automobile tires which make up the bulk of the raw material, are first ground and sized so as to simplify efficient penetration of the softening oils and caustic soda during the cooking or de-vulcanizing stage. In the devulcanization treatment the fabric is dissolved by the caustic soda, and the rubber is softened and plasticized by the added oils, and by heat and pressure. After the cooking operation the excess liquor is drained off and the mass is washed with water in order to remove alkali and other undesirable materials. This is followed by the recovery of the fine rubber from that portion of the liquor not returned to process. The drained and washed particles are dried so as to increase the adhesion. Several batches of rubber particles are blended and mixed with certain oils and pigments, which are added to give the compound specific characteristics. It is then made into a mass on a roller mill and further plasticized by passing between tight iron rolls, sufficient to allow straining, which removes small metal particles not previously caught by the magnetic separator. The final operation is one of refining and forming into slabs between iron rolls, usually set much closer together than in the previous operation.

The diagrammatic flowsheet and the illustrations are from the Akron, Ohio, plant of the Goodyear Tire & Rubber Co.

Quality is controlled by means of sampling and testing finished product and by spot tests at various stages in processing. Temperatures and times are checked by recording instruments, with automatic controls used extensively.

The nature of the final product may be varied somewhat by varying the kind and age of tires used as starting material; by changing the time and temperature used to cook; by addition of different oils or solids prior to the mechanical processing after drying, and by increase or decrease in degree of mechanical working on refiners or finishing rolls.

CHEMICAL & METALLURGICAL ENGINEERING

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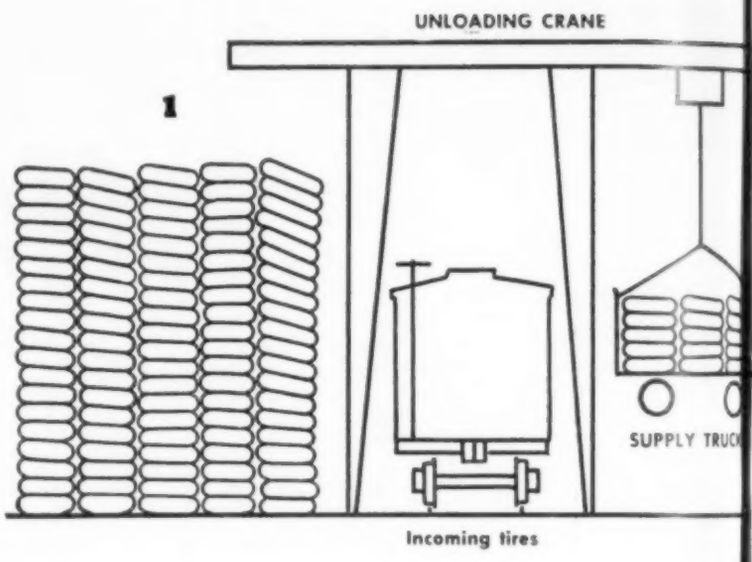
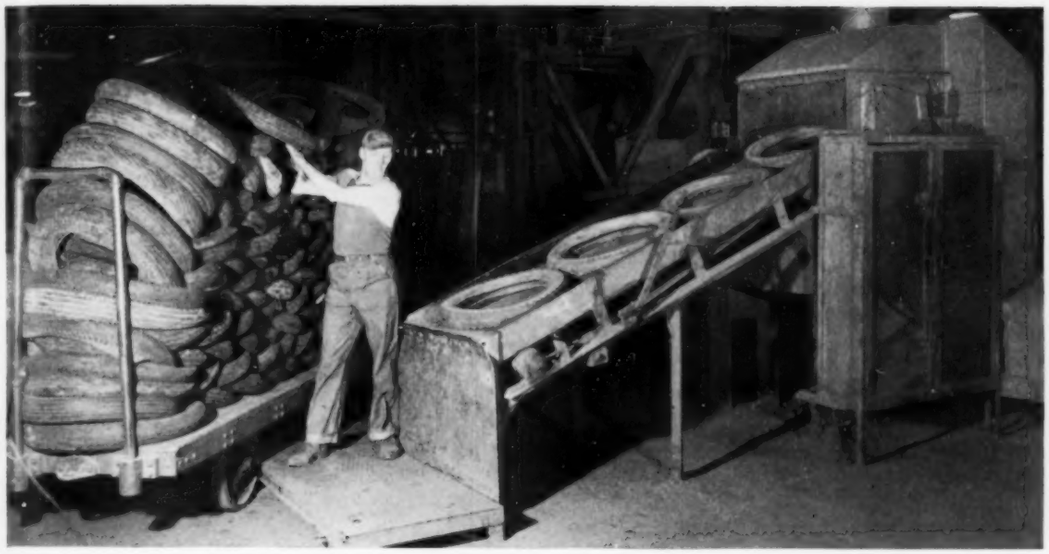
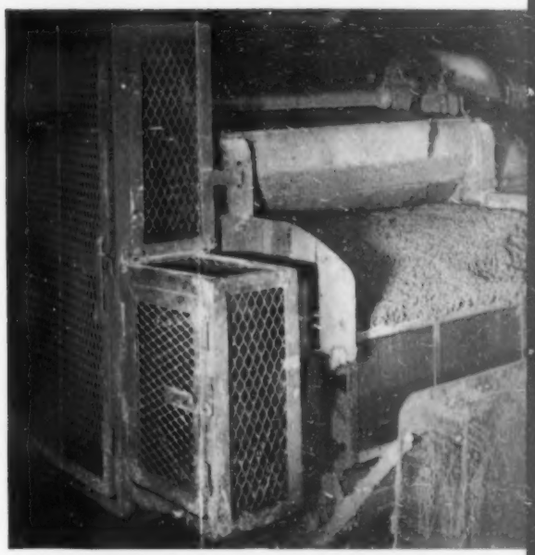


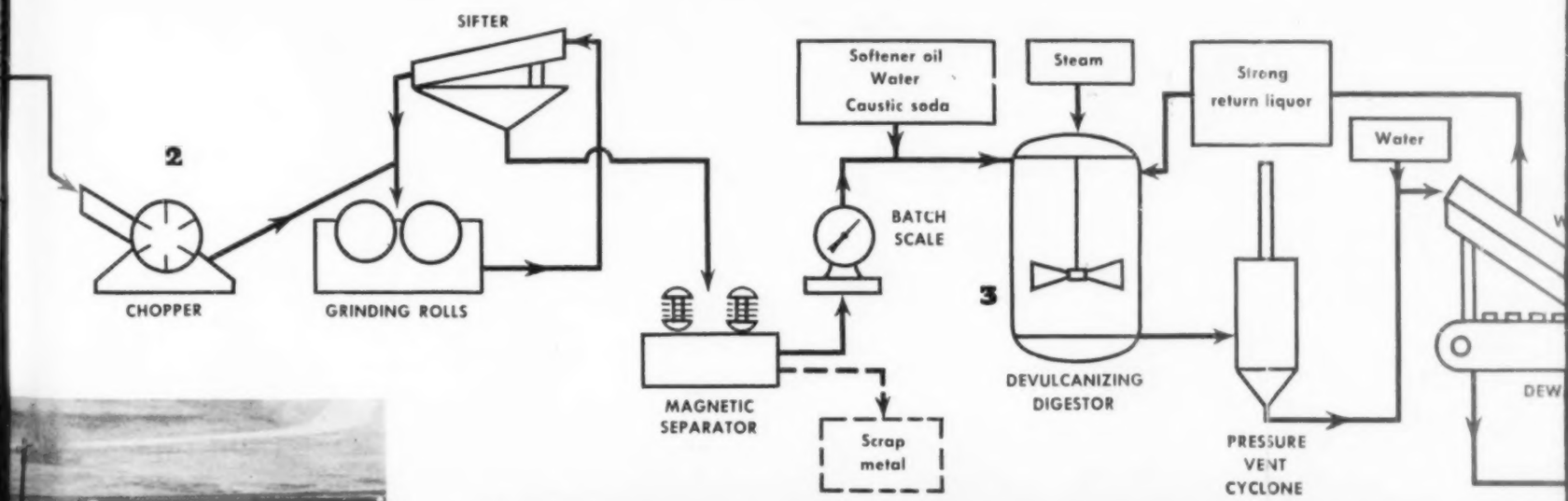
1 Cast off automobile tires are the principle source of raw material for the reclaiming plant. Reclaimed rubber is advantageous in compounding many rubber products

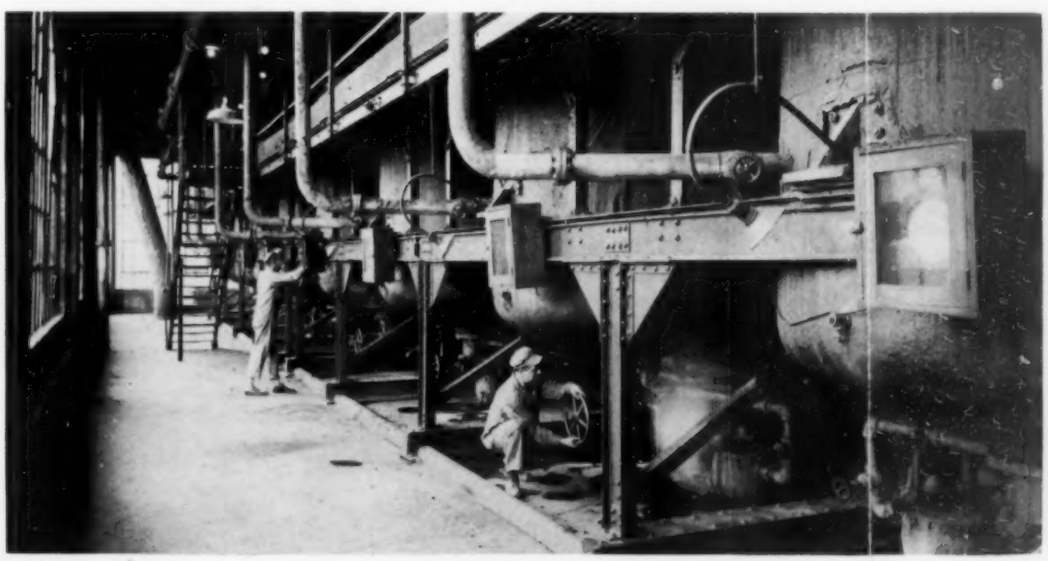


2 Processing of the old automobile tires starts by passing them through a grinding machine shown above which tears them apart into small sections



4 Rubber is next given a thorough washing and passe in order to remove excess moisture. At this stage ru



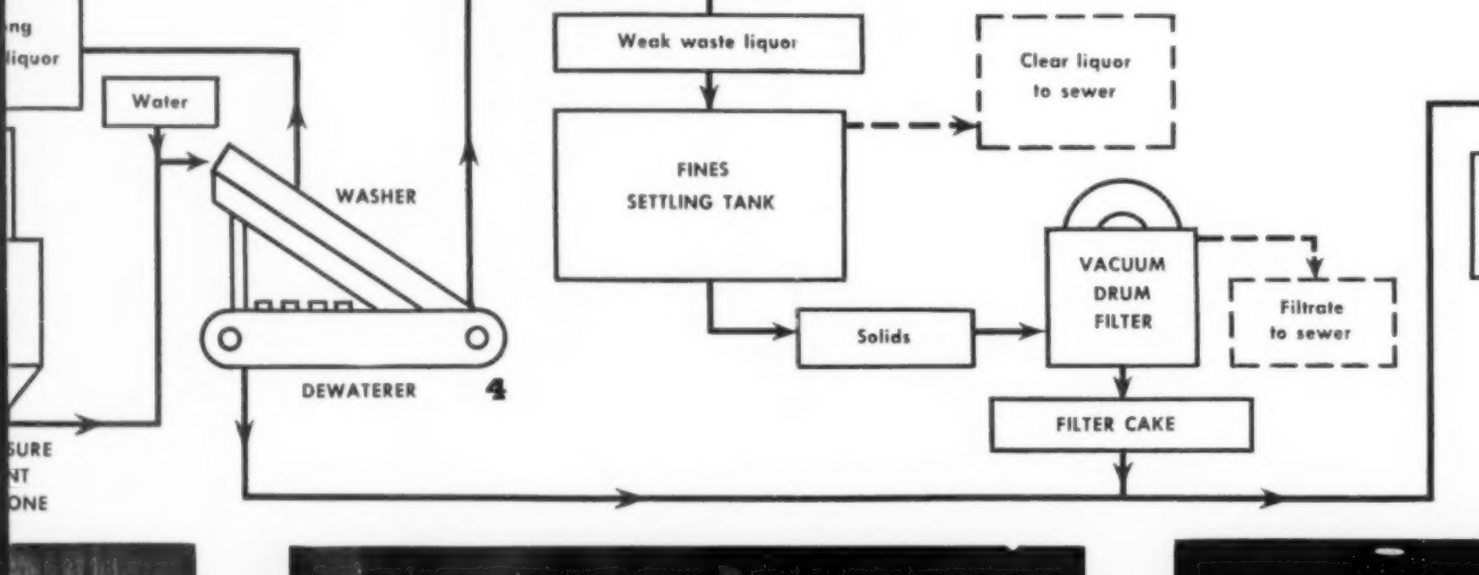


3 Cotton remaining after the screening operation, plus ground rubber, now goes to devulcanizers where high temperature and oils continue the breakdown and destroy cotton

5 It moist

ven a thorough washing and passed over a series of screens
excess moisture. At this stage rubber is in small particles

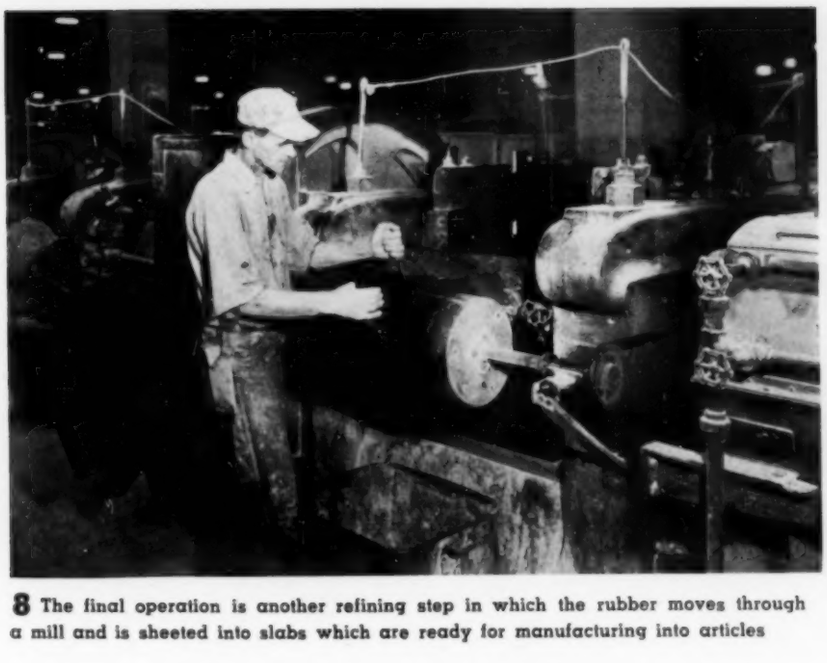
6 The dried rubber is then weighed and the oils and pigme
obtain specific properties. These materials are passed throug



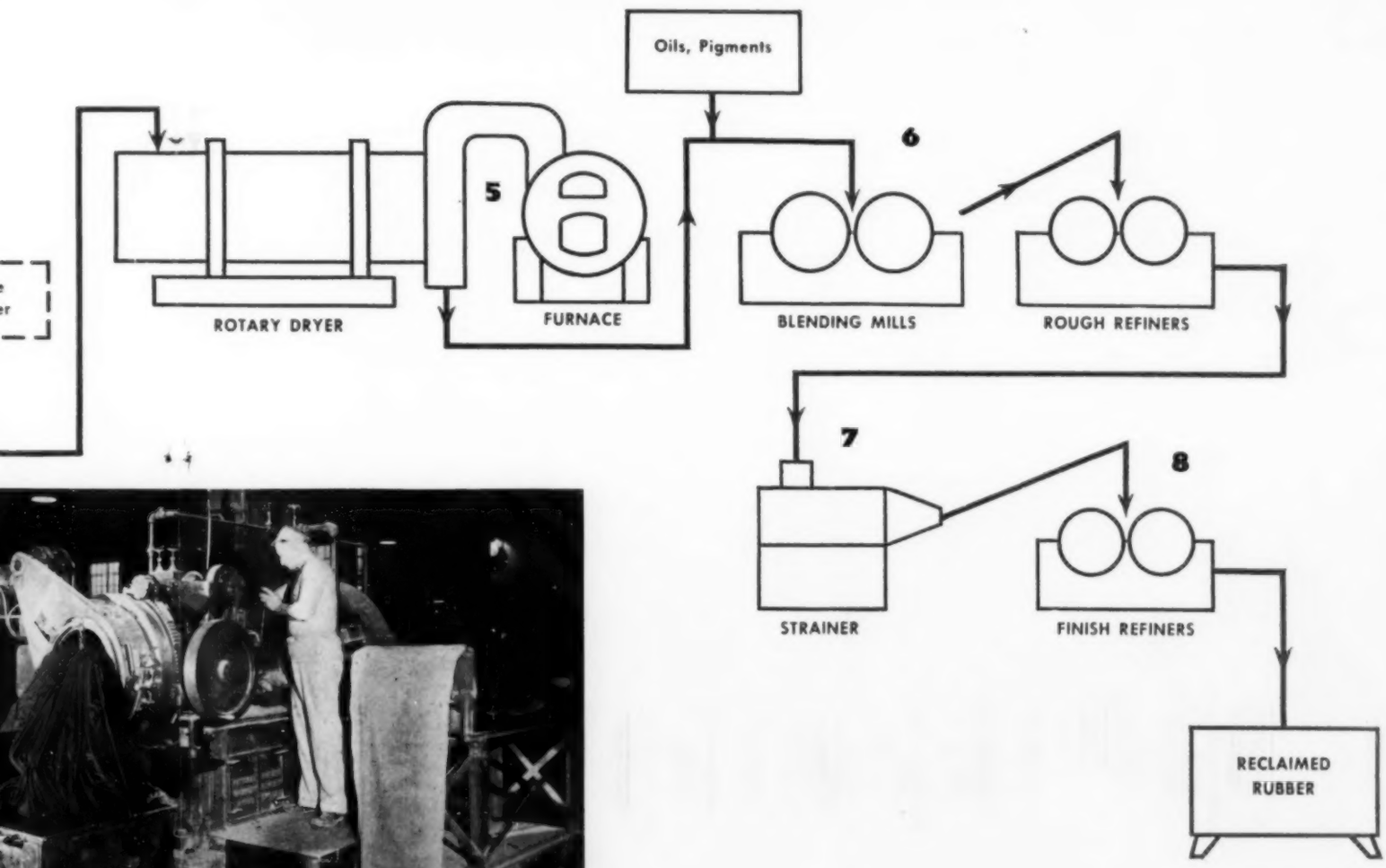
5 It is conveyed to a large rotary tank heated by oil-fired furnaces. Excess moisture is removed before the rubber is milled and refined

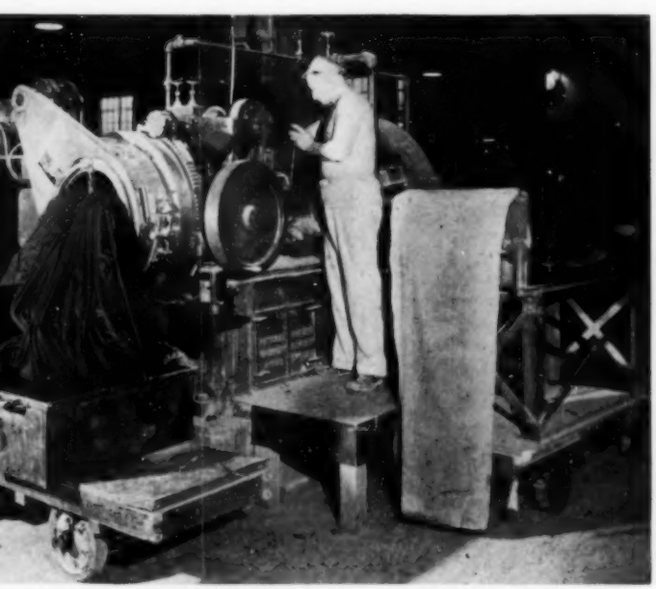
7 A strainer, which looks like
A screw forces the rubber thr

oils and pigments added to
passed through apron mills

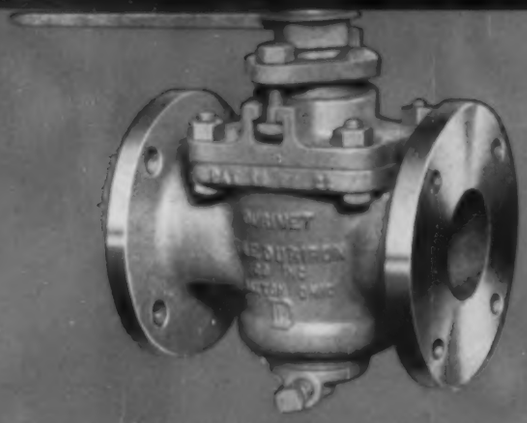


8 The final operation is another refining step in which the rubber moves through a mill and is sheeted into slabs which are ready for manufacturing into articles



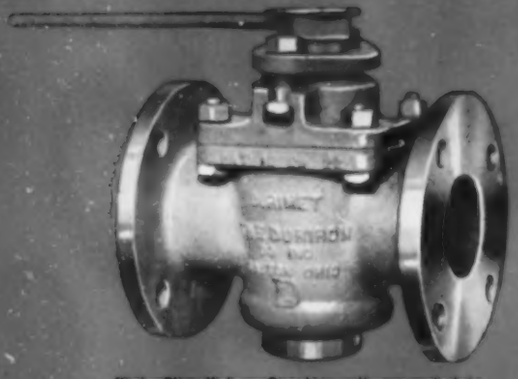


hich looks like a food grinder, removes foreign matter and metal.
the rubber through the machine

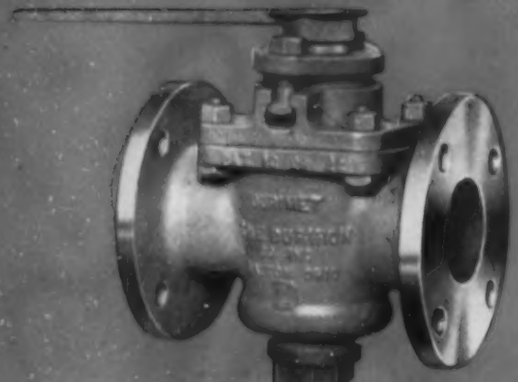


Lubricated Plug Valve. Changing fitting makes a Combination Lubricated and Plunger-Release Valve.

Combination Lubricated and Plunger-Release Valve. Combines hydraulic and mechanical plug releasing features.



Plain Plug Valve. Can be easily converted to Plunger-Release Valve.



Plunger-Release Valve. With a mechanical plug releasing feature.

Do you know ABOUT THESE VALVES ?

Corrosion and abrasion principally affect the plug in plug type valves.

Durco Stainless Steel Valves meet this condition with advantages possessed by no other corrosion-resisting valves.

The body of Stainless Steel permits rough handling and use under high pressures. Although the plug may be furnished in Stainless Steel also, plugs of Duriron or Durichlor are receiving wide acclaim because they are extremely hard and highly resistant to galling and abrasion, and superior to Stainless Steel for handling many corrosive solutions. The result is a valve of maximum durability.

SIMPLE CHANGE PROVIDES WIDER APPLICATION

Furthermore, Durco valves are designed in such a way that the plug type valve can be converted into a plunger-release plug valve, or a lubricated plug valve can be made into a combination lubricated and plunger-release valve, by simply changing the fitting at the bottom of the valve.

This greatly increases the number of possible applications for the valves.

Send for Bulletin 604-D. It gives complete data and specifications. You should have it handy.

DURIRON · DURICHLOR
CORROSION-RESISTING
DURCO
ALLOYS & EQUIPMENT
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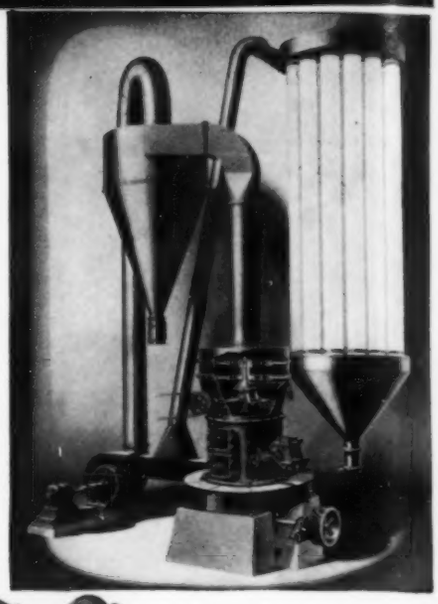
RAYMOND EQUIPMENT

PRECISION PRODUCTION is becoming more important in the chemical, food and process industries where close specifications must be met in making powdered materials. This accounts for the dominant use of Raymond pulverizing and separating machinery in the manufacture of superfine, high purity products, such as chemical hydrate, insecticides, pigments, plastic compounds, and other fine, dry, impalpable powders.

A diversified line of different type mills provides an answer to many exacting problems not only in methods of handling but also in the character of finished materials. Inquiries are welcomed on special problems involving powdered products.



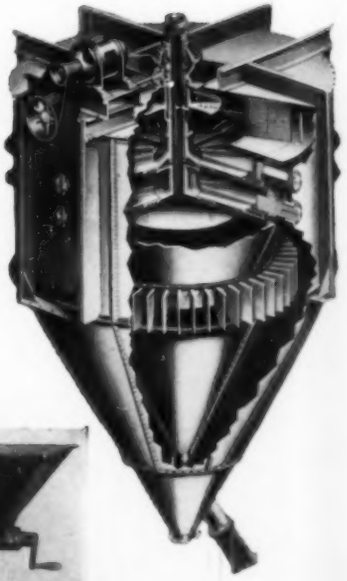
FINISH GRINDING OPERATIONS

Raymond Roller Mills are equipped with Air Separation for pulverizing and classifying materials to finished fineness. Whizzer type separators, built-in-the-mill, give wide range fineness control, valuable in pigment grinding and other special operations. Heated air may be passed into the mill for evaporating moisture from the product while pulverizing.

Ask for descriptive bulletins of machines in which you are interested.

DRYING and PULVERIZING

Raymond Imp Mills are high speed, impact type pulverizers which are adaptable to a variety of specialized grinding operations. Equipped with flash drying, the Imp Mill is used on such problems as removing four of the five molecules of water of crystallization from copper sulphate, and delivering a fine, dry, uniform powder.



SUPERFINE CLASSIFICATION

Raymond Mechanical Air Separators, with single or double whizzer, are used for classifying powdered materials to desired fineness up to 99.99% passing 325-mesh. Also efficient for separating the mill grind from practically any type of pulverizer, operating in closed circuit.

LABORATORY TESTING

Raymond Laboratory Mills and Laboratory Separators are built on the same principle as the larger commercial sizes of Raymond machines. They provide an accurate method of making tests on materials or developing new products.

RAYMOND PULVERIZER DIVISION
COMBUSTION ENGINEERING COMPANY, INC.
1311 North Branch Street CHICAGO
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SINCE 1887

Timesaving Ideas for Engineers

Chem & Met PLANT NOTEBOOK

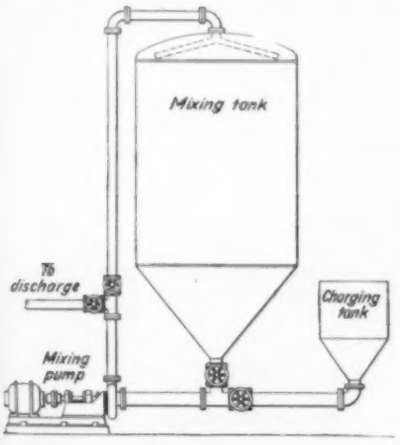
SPECIAL PUMPS EFFICIENT MIXERS FOR SLUDGES CONTAING FIBERS AND SOLIDS

VICTOR J. MILL President and General Manager
Lawrence Pump & Machine Corp., Lawrence, Mass.

PUMPS are seldom thought of as mixers or agitators, yet they are widely used for this purpose on various liquids and semi-liquids, especially for sludges containing fibrous and solid materials in suspension. A pump when properly designed for this service makes a very efficient mixer and agitator and possesses many advantages.

Mixing is ordinarily induced by creating haphazard currents within the liquid to be mixed through some mechanical means, and continuing the operation until the desired degree of uniformity has been reached throughout the whole batch. This is best illustrated in the familiar case of a spoon and the mixing bowl.

Fig. 1—Typical arrangement of mixing plant, using pump as a mixer



All of the common types of mixers and agitators operate on this principle and possess some dead spaces and corners where mixing is not done thoroughly. Further, a mixer with revolving parts produces a certain amount of centrifugal action which tends to segregate the materials according to their specific gravity.

Pump Mixing Action

With a pump, on the other hand, the mixing process is entirely different and the system can be made free of any dead spaces or corners with a properly designed mixing tank. Moreover, the centrifugal action in the pump does not tend to separate materials of different specific gravities.

The action of a pump when used as a mixer may be divided into three distinct stages: (1) mixing or agitation which takes place within the pump itself; (2) mixing induced through flow in the pipe; and (3) agitation produced in the mixing tank by the return stream. This is best illustrated by Fig. 1 which shows a simple arrangement of mixing installation, with the pump used as a mixing and agitating element.

In this particular arrangement the batch of liquid or semi-liquid to be mixed is charged into the mixing tank and circulated through the pump and pipe line until the desired degree of uniformity has been attained.

Considering the different stages of mixing in detail, it may be explained that, in the first place, as the stream of material enters the pump suction it is divided into several small streams while passing through the impeller; and after being whirled around at the rate of several hundred revolutions per minute within the casing, it is reunited into a single stream as it leaves the pump. This stream is bound to be absolutely uniform throughout its cross section.

The second stage of mixing, that induced by the flow through the pipe, is due to the fact that the flow in the pipe is not uniform throughout its cross section, but is faster in the center than along the walls of the pipe. In this way a considerable amount of mixing takes place longitudinally within the pipe, and this is augmented further by the turbulence produced by the valves and fittings in the line.

The third stage, that is the agitation produced by the discharge stream, will vary according to the discharge velocity which, in turn, will vary according to the pressure developed by the pump. The greater the pressure, the higher the discharge velocity and the amount of agitation produced by the discharge stream; and the shorter is the time required for the thorough mixing of a given batch.

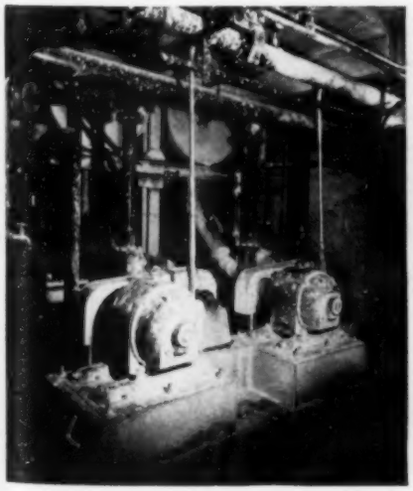
Referring to Fig. 1, and taking the batch to be mixed at 2,500 gal. and the pump at 4-in., with a capacity of 400 g.p.m.; if the batch were passed through the pump but once, it would result in a cylinder 4 in. in diameter, and 4,200 ft. long. This would require 6¼ minutes of pumping.

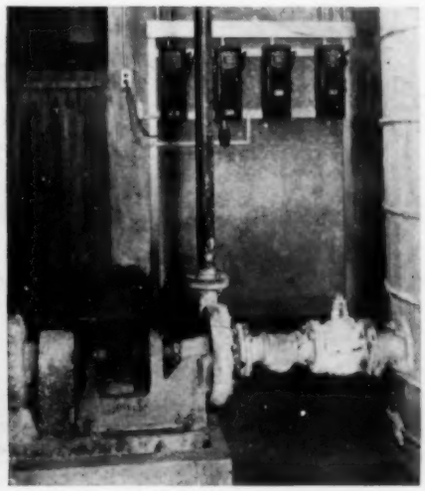
This cylinder would be absolutely uniform in cross section at any given point due to the mixing action which takes place within the pump itself, but it might vary somewhat in consistency along its length. However, by discharging back into the tank and continuing the pumping, the different portions of this cylinder become intermingled; first, due to the longitudinal agitation produced within the piping and, secondly, by the discharge back into the mixing tank. In this way, after a short time, the whole batch becomes uniform throughout.

The action of the pump on the batch of material in this case may be compared to that of a rolling mill on a bar of steel which is bent back and rolled out again a large number of times.

It should be pointed out that prac-

Fig. 2 and 3—At the left are two 4-in. mixing pumps, arranged for V-belt drive, handling a heavy asbestos sludge used in making wallboard. At the right is a 3-in. direct-connected mixing pump circulating a mixture containing a small quantity of solids in suspension, for the purpose of keeping the mixture uniform





tically the entire power input, less only the mechanical losses in the bearings, is utilized in doing useful work. The stray currents which in ordinary pumping are classified as "loss" are in this case performing useful work; that is, the mixing which takes place within the pump itself.

In addition to its high mechanical efficiency and the thoroughness of mixing, there are additional marked advantages in the use of a pump as a mixer where slurries containing abrasive materials or materials of fibrous character are involved.

In the case of abrasive materials, there are no moving parts or bearings within the tank itself and the wear is confined exclusively to the pump parts; that is, parts which are comparatively small and can be made of abrasion resisting alloys, and which can be readily renewed when worn out.

In the case of sludges or slurries containing fibrous materials, there is a marked tendency with the pump to straighten out the individual fibers and to distribute them uniformly throughout the mixture. Further, there are no places for the fibers to catch and form bunches of fibrous matter.

This straightening action was illustrated recently in the case of a well-known manufacturer of wallboard who found that the strength of the board was increased 25 percent when using the pump as a mixer, all other conditions such as composition being the same as formerly. The result was attributed to the straightening out and the better distribution of the asbestos fibers.

Paper Stock Hydration

In line with this, it has been found that the hydration of paper stock can be accelerated by circulating it with a pump due, no doubt, to this same tendency to straighten out the individual fibers and to distribute them uniformly throughout the mixture.

In addition to serving as a mixer, the same pump can be used for charging the mixing tank and for unloading the batch after mixing, as illustrated in Fig. 1.

In order to serve satisfactorily as a mixing apparatus, the pump must be of correct design and constructed of proper materials, which is particularly true of a pump for handling fibrous, abrasive or corrosive materials.

The capacity and the pressure to be developed by the pump must be given due consideration in order that the system, as a whole, may be well balanced and perform at the desired rate. Unless these factors rule the design and selection of the pump, the system will not function efficiently and, in addition, may be expensive to operate and to maintain. Other factors that may need to be allowed for are clogging tendencies or liberation of gases which, with the wrong design, would cause air binding.

The intrinsic merits of the pump as a mixer, as evidenced by a large number of successful applications, coupled with recent developments of special pumps for the purpose, make is deserving of consideration in all problems of mixing and agitating liquids or semi-liquids.

SPECIFIC HEAT CHART FOR COMBUSTION GASES AIDS SOLUTION OF HEATING PROBLEMS

DALE S. DAVIS Chemical Engineering Dept., Wayne University, Detroit

IN DEALING with heat balances on furnaces and gas producers, many chemical engineers use 1 lb. of fuel fired as the basis and compute, by means of the gas analysis, the volumes, in cubic feet, of air, stack gas and producer gas. In calculating preheat, sensible heat losses, hot efficiencies, and maximum theoretical temperatures, there is need for good data, conveniently presented, covering the specific heats at constant pressure of CO_2, CO, O_2, H_2, N_2, CH_4, water vapor and air. The best data appear to have been assembled in Fig. 1 of the "Principles of Chemical Engineering," where the mean molal heat capacity (Mc_p) between 60 deg. F. and the temperature is plotted against temperature. In some instances they are 5 per cent higher than the Eastman data but are of spectrographic origin and are believed to be the best now available.

These data, read from a full scale copy of this chart and recalculated on the basis of B.t.u. per 1,000 cu.ft. per deg. F., are presented in the table and in the accompanying chart. The chart is helpful in enabling easy interpolation, particularly in computations of maximum theoretical temperatures where trial and error methods are usually employed. Those who are using Carr and Selheimer's "Fuels and Their Utilization" industrially or as a text in combustion will find the chart a convenient supplement to the heat balance chapter.

For heat balance calculations on furnaces and gas producers, this specific heat chart based on best available data facilitates computations and enables easy interpolation in the table at the lower right

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H_2 — Davis and Johnston, *J. Am. Chem. Soc.*, **56**, 1045 (1934).

O_2 — Lewis and von Elbe, *ibid.*, **55**, 507 (1933).

N_2, CO—Johnston and Davis, *ibid.*, **56**, 271 (1934).

CO_2 — Kassel, *ibid.*, **56**, 1838 (1934).

H_2O — Gordon, *J. Chem. Phys.*, **2**, 65, 549 (1934).

Mean Heat Capacities at Constant Pressure Between 60 Deg. F. and any Temperature t, in B.t.u. per 1,000 Cu. Ft. per Degree F.

t	CO_2	H_2O	N_2	H_2	CO, Air	O_2	CH_4	
0	22.90	21.25	18.40	18.10	18.40	18.45	22.25	(0° F.)
200	24.40	21.50	18.40	18.30	18.45	18.65	22.91	(100° F.)
400	25.70	21.70	18.45	18.35	18.60	19.00	23.81	(200° F.)
600	26.85	21.95	18.65	18.40	18.70	19.35	26.78	(500° F.)
800	27.90	22.25	18.80	18.45	18.90	19.70	30.43	(850° F.)
1,200	29.55	23.05	19.20	18.60	19.35	20.25		
1,600	30.85	23.90	19.65	18.75	19.85	20.75		
2,000	31.90	24.65	20.00	18.95	20.20	21.15		
2,400	32.75	25.40	20.30	19.20	20.55	21.45		
2,800	33.45	26.15	20.60	19.45	20.85	21.75		
3,200	34.10	26.90	20.90	19.70	21.10	22.00		
3,600	34.60	27.50	21.10	19.95	21.30	22.25		
4,000	35.05	28.10	21.30	20.20	21.55	22.50		

Technical, Industrial, Personal

SHARP INCREASE IN DOMESTIC NITROGEN CAPACITY

Potential capacity for the production of nitrogen soon will reach 800,000 short tons a year as compared with a production of 424,000 tons in 1939 according to estimates contained in a report submitted by Dr. R. R. Sayers, Director of the Bureau of Mines, to Secretary Ickes.

With construction of three synthetic chemical nitrogen plants now under way and a contemplated increase of byproduct nitrogen as a result of additions being made to the capacities of byproduct coke-oven plants, it is estimated that sufficient capacity should be available within the country to make the United States independent of imports of chemical nitrogen.

Before this projected capacity becomes available, however, the Bureau states, a considerable portion of our normal requirements of chemical nitrogen will have to be supplied by imports. Even when the full capacity of presently planned synthetic nitrogen plants becomes available imports may nevertheless be needed in the event of a national emergency.

The report shows that production of fixed nitrogen in the United States for 1939 was 280,000 tons, but by substantial modernization or alteration of existing equipment capacity could be substantially increased to about 410,000 tons a year with the new plant construction. Three synthetic ammonia plants (including the rehabilitation of United States Nitrate Plant No. 2 at Muscle Shoals) are under construction. On completion of this program of expansion, the combined production capacity of synthetic chemical nitrogen plants will be about 600,000 tons a year.

CHEMICAL COMPANIES FORMED AT EDGEWOOD ARSENAL

Two new companies to increase the Army's defenses against chemical attack were created at Edgewood Arsenal, Maryland, on June 1. They are the Second Chemical Co. (Decontamination) and the First Chemical Co. (Impregnating). The function of the Second Chemical Co. will be to eliminate any enemy gases and chemicals employed against supply and evacuation establishments. It consists of a company headquarters and three platoons, with a total strength of approximately 200 officers and enlisted men. Each platoon is made up of a headquarters and six decontamination squads.

The First Chemical Co. decontaminates and renovates the clothing of soldiers who have been exposed to persistent gases. The company consists of approximately 150 men organized into a company headquarters and 3 platoons. Each platoon is capable of operating as a separate unit when required.

SHELL OIL WILL BUILD SECOND TOLUOL UNIT IN TEXAS

Shell Oil Co., Inc., last month announced the award of a contract for the erection of an additional petroleum toluol plant at its Houston refinery. According to Dr. R. H. Waser, manager of the refinery, this plant will be a duplicate of America's first petroleum toluol plant which went into operation there last December. The combined capacity of these plants will be 4,000,000 gallons per year.

Shell research scientists have perfected two processes whereby toluol can be manufactured from petroleum. The first of these—the one to which the new plants are adapted—is a process by which toluol is obtained from crude oil by distillation and solvent extraction. The second process involves the rearrangement of petroleum molecules under heat and pressure to give toluol. If need be, this second process can be utilized to supplement the first.

The contract for the new Shell plant has been awarded to the C. F. Braun Co., of Alhambra, Calif., and is expected to be completed by Oct. 1.

FERTILIZER TRIAL SET FOR NEXT JANUARY

Pleas of not guilty were entered in the anti-trust suit by most of the fertilizer industry companies and individuals who are defendants. However, the Superphosphate Association and its member companies and the individuals representing them entered a plea of nolo contendere on the opening of the court proceedings at Winston Salem, N. C., May 12. One company and one indivdual were eliminated from further proceedings by a government motion.

The court set January 5, 1942, as the date for beginning of the trial of the defendants remaining for court consideration. When the trial opens, it is expected to extend for a period of six to eight months. Meantime, elaborate preparations are being made by the industry for suitable defense through cooperative action. In effect, the National Fertilizer Association, one of the defendants, is serving as a central coordinating agency in these matters.

AMERICAN POTASH STRIKE HITS POTASH AND BORAX

The strike of the employees of American Potash Chemical Co. at Trona, Calif., which began March 14, was still before the National Defense Mediation Board at the end of May. Not only has production of borax, boric acid, potash chemicals and lithium products been interrupted, but also shipment of stocks on hand at Trona has been prevented. As a result, Western users of potash chemicals, and Eastern glass and chemical companies depending on crude lithium and borax supplies, have had difficulties.

About five years ago labor troubles of this company began with the discharge of certain employees who subsequently persuaded N.L.R.B. that they had been discharged for union activity. These men were finally rehired and financial settlements made with them in 1940. But it was not until January, 1941, that N.L.R.B. certified to the company that the C.I.O. subsidiary was the recognized bargaining agency for the employees of the company.

DECREE FILED IN NITROGEN ANTI-TRUST SUIT

The Department of Justice on May 29, announced the filing of a complaint and entry of a civil decree in the U. S. District Court for the Southern District of New York against the Allied Chemical & Dye Corp., The Barrett Co., Semet-Solvay Co., The Solvay Process Co., and E. I. du Pont de Nemours & Co., for alleged violation of the antitrust laws through restraints in the production and sale of fertilizer nitrogen.

The decree provides for far-reaching changes in the marketing of agricultural nitrogen, requiring Allied Chemical, The Barrett Co., Semet-Solvay, and Solvay Process to discontinue, after a period allowed for adjustment, the present Nitrate Agency plan of distribution. These companies are enjoined after April 1, 1943, from employing the producer agency contract (the present method of distribution) or from setting resale prices to be charged for nitrate of soda by mixed-fertilizer manufacturers or dealers. Similarly, the Sulphate of Ammonia Agency, which The Barrett Co. has operated for many years, will be limited, after an interval of adjustment, to 35 percent of the domestic production of sulphate of ammonia sold for domestic consumption. The complaint alleges that in a recent year The Barrett Co. controlled approximately 80 percent of the domestic production of sulphate of ammonia. The Barrett Co. is also enjoined from any exclusive agency contract.

News from Washington

WASHINGTON NEWS BUREAU, McGRAW-HILL PUBLISHING CO.

AUTHORITY for "all-out" action by the President and his aides is now available. In view of the priority authorization, the act signed by the President at the month end, it is not quite evident why the War Department is asking for additional authority in the bill of very sweeping phraseology recommended by it to Congress on June 2. Nevertheless, this bill, though sharply criticized, will probably be passed. And then personal affairs as well as all industry activity will be subject to government orders.

Shortage of industrial materials becomes increasingly evident in many fields. This is going to compel the extension of priority rules to many commodities of which it appeared even a few months ago that there was an abundance. The purpose of such priority rulings will be not only to supply defense with the goods wanted, but also to reduce industrial activity elsewhere. This reduction is planned both to curtail public spending on non-essentials and to make available more skilled workers from industries that slow down. These men will, of course, be expected to transfer to the speed-up defense plants in which their skills are needed.

Despite the authority to achieve these general changes, Washington has been proceeding in a piecemeal fashion. Perhaps the most serious criticism of the Administration has been that little drastic action is taken until situations are badly confused; and even then many of the actions taken are of paliative rather than fundamental nature.

Goods Shortages

Chemical process industries are already experiencing unexpected varieties of goods shortages, or difficulties of supplying their normal markets. Perhaps most conspicuous in the May discussions have been the troubles of petroleum industry. The gasless Sundays of World War days will probably have to be imitated this year. And some users of fuel oil will probably have to go without unless new transport capacity can be quickly developed. Transfer of tankers from normal Gulf Coast to Eastern seaboard runs (mainly to aid Britain) leaves the Northeastern area seriously short of petroleum products.

Substantially all metals are now under priority control of either voluntary or mandatory form. Thus, a priority order based on some government business is becoming increasingly necessary even for equipment repairs, and spare parts. The inadequacy of steel capacity long denied was finally recognized the first of June. But the revised Gano Dunn report probably fell far short of a complete picture of the inadequacy of steel supply expected next year. Some even estimate that perhaps 25 percent of normal civilian usage of steel may be interrupted for defense manufacture.

Shortage of electric power has been aggravated by the Spring drought in many Eastern states. T.V.A. has already begun rationing of energy supply for electrometallurgical and electrochemical activities. Even with generous rainfall during summer, it is unlikely that all of the normal activities in many water sheds can be supplied because the power requirements have expanded beyond installed electricity generating capacity. And the building of new power generating facilities on short notice has become impossible because of the congested conditions of equipment shops.

Perhaps most direct in its impact on defense work has been the bad unbalance in explosives manufacture. The Army has not been able to coordinate accurately the production of propellent powder (smokeless) with the output of high explosives (mainly TNT) and the production of shells and ammunition components. Thus, some parts or supplies are piling up beyond convenient storage capacity and other essentials of complete ammunition are wholly unavailable. Washington fears that shortage of ammonia later this year and early next year may further aggravate this already bad situation.

Aluminum and Magnesium

War's insatiable demand for aluminum and magnesium has skyrocketed current estimates of needed production capacities to a minimum of 1,500,000,000 pounds of the former and at least 150,000,000 pounds of the latter. Both goals, at the end of May, were short by a margin greater than the entire 1939 production.

It is now recognized that government money will have to finance all the additional capacity, about 500,000,000 pounds of aluminum and 75,000,000 pounds of magnesium. Present "built or building" capacities are 900,000,000 pounds of aluminum (plus 200,000,000 pounds from Canada) and 75,000,000-80,000,000 pounds of magnesium. Decision that the government will enter the field has opened up a shart squabble between OPM and anti-monopoly-minded New Dealers, the latter arguing against permitting Aluminum Co. of America to operate the additional facilities and in favor of outright government ownership with "temporary" private industry management on a fee basis. Alternative is a Defense Plant Corp financing arrangement which carries an option to the private operator to buy the plant at the end of the emergency.

At the end of May it appeared certain that Reynolds Metals Co., which began production of virgin aluminum during the month, would get the job of operating 200,000,000 pounds of government plant capacity, that Alcoa would get a big chunk of the remainder and one or more of the fabricators the rest. Reynolds itself spiked New Dealers hopes that the entire government-sponsored production could be diverted from Alcoa by taking the practical viewpoint that it could not stretch its operating staff beyond the 200,000,000-pound limit.

Cost of the government adventure into aluminum and magnesium, according to estimates of Federal Loan Administrator Jesse Jones, will total around $300,000,000, including investment in fabricating facilities. In skyrocketing the estimates of the light metals, however, neither OPM nor the New Dealers apparently have given much, if any, consideration to the ratio between these capacities and the supply of other "war metals" for which "ultimate" limit of capacity can be calculated, copper, for instance. In fact, it is rather openly conceded that OPM's aluminum and magnesium estimates of need were put at a level high enough to assure adequately supply "once and for all."

In addition to the stupendous addition to domestic production facilities contemplated, RFC, at the instance of OPM, has negotiated a purchase of 340,000,000 pounds of aluminum from Canada for delivery over the next two years. Price was announced as $63,000,000, which figures out to around 18.5 cents per pound. This 1.5 cent premium over domestic price is understood to have been agreed upon as a means of strengthening Canadian dollar exchange. Of the purchase price, $25,000,000 is being paid in advance to finance expansion of Canadian production facilities.

Munitions Plants

Delays in contracting for the second chain of government munitions plants has reached the point of causing some undercurrent of concern in defense quarters. The situation is not clear enough for attaching blame but it is true that the Army's high hopes of getting the new construction underway early to take advantage of spring and summer weather are dwindling day by day. In OPM quarters concern is felt lest the delays prevent completion of powder and shell plants soon enough to load the weapons of tanks, guns and planes now building.

Site and management problems are given as the major reasons for the fact that at the end of May none of the second series of plants was under contract, money for which has been available for weeks. Both these problems are leading to one answer which modifies previous plans—there will be vast expansion arranged at sites of the first chain of plants now building or in operation. It is still contemplated to locate additional smokeless, TNT and similar factories west of the Mississippi

but indications are growing that a large portion of the money for these purposes will go for additions at present sites, where existing management can take on the added load and where transportation to Atlantic ports is quicker and easier.

Early in June the War Department announced that Chattanooga, Tenn., had been selected as a site for a TNT plant to cost $39,000,000. It also was announced that a shell loading plant would be built at Parsons, Kans., to cost $35,000,000 and another at Texarkana, Tex. to cost $45,500,000. In all three cases the authorization includes funds for the purchase of land, construction of buildings, building installations, machinery and equipment.

Allocation of Cork

The nation's supply of cork, estimated to be about 45,000 short tons on June 1, and all future imports are now "impounded" and subject to release only under direction of OPM's Priorities Division. Allocations will be made monthly first to defense orders and secondly to non-defense uses under the following formula:

First, for civilian uses essential to public welfare; second, to minimize hardship on labor or business; third, in proportion to past requirements and to insure an equitable distribution; fourth, in relation to the availability of substitutes. In all civilian allocations, persons discriminating against defense orders will be subject to being cut off from supplies.

Cork imports last year totaled 207,000 short tons and because of world conditions and shipping shortage, 1941 imports are estimated at 121,000 to 150,000 tons. Total defense and civilian requirements for 1941 are estimated at 172,000 tons.

For the present, at least, cork uses in floor coverings, which take about 10 percent of normal supply, and insulating board, taking 40 percent normally, are expected to share the bulk of curtailment to maintain adequate supplies for cap linings, gaskets and washers and other types of insulating products.

Price Controls

The broad OPACS policy described in these columns previously is being pressed by Administrator Henderson, but still on a spot or emergency basis. He has thus far resisted the proposal that all prices be frozen at former levels and then relief be given as need may be demonstrated. During May, action was taken with respect to certain textile yarns, kraft paper, ammonium sulphate for fertilizer use, soap oils, and various other commodities which are products of process industry.

No formal price-fixing has yet developed on chemicals, however. In most cases actions have been limited to requests that prices be maintained at the level of recent quotations. This was the form used in the action on ammonium sulphate, for which byproduct coke-oven producers were requested to continue base prices of $28 per ton which prevailed during the latter part of the last fertilizer year.

Administrator Henderson has announced that he will urge O.P.M., Labor Department, and others dealing with wages to avoid wage increases that will start upward price spiraling. But the effectiveness of such a request is questioned in view of the fact that mediation and conciliation efforts, primarily concerned with continuing defense work, generally lead to wage increases.

Under Dr. J. K. Galbraith, who heads the Price Division of OPACS, a chemical division is being organized. This unit will deal with fact finding matters and report to the executives of OPACS recommendations regarding chemical price controls. Temporarily, Dean Harry A. Curtis, of the University of Missouri, is advising regarding the organization of this project.

Anti-Trust Relief

During the last few weeks the Department of Justice has developed a new philosophy of defense cooperation. Attorney General Jackson has announced categorically the approval of the formation of industry committees when these are required by O.P.M. or OPACS. Exemption from prosecution for violation of the monopoly laws is promised when bona fide cooperation on necessary defense undertakings is carried out in good faith. However, the Justice Department reserves the right to begin a civil action to enjoin further cooperation if it later develops that this is not in the public interest, and if such actions continue after notice to desist has been given to industry.

Despite this measure of relief in broad policy matters, the Department continues to press the charge against certain industries that foreign control is still exercised unreasonably through ownership abroad of patents. The current investigation of this subject is being continued; and with the enlarged funds granted for the next fiscal year, the inquiry may be extended into new areas subject to suspicion as to the legality of present practices alleged to be influenced from abroad. The Department gives the impression that it thinks that German influence is particularly obnoxious in certain chemical fields.

Chemical Miscellany

Export Controls—Numerous additional commodities are now subject to export control. And the effect of the export license act has been extended so that movement of goods out of the Philippines to foreign destinations requires license for any commodity which would need such a permit for movement from continental United States. This plugs a gap from which exports of fats and oils and other commodities were leaking into undesirable Oriental trade channels.

Trade Treaties—The State Department announced the middle of May that it was negotiating new trade agreements with Argentina and Uraguay. Quite a number of commodities of chemical interest will be considered among goods for which tariff concessions may be granted to these Latin countries. As in all former negotiations, any concessions granted in a single treaty will be applicable to imports from any country, not only the one with which the agreement is made.

Inventory Controls—Procurement of many classes of goods, including practically all important industrial metals, requires a report from the purchaser on stock on hand as well as his prospective need. This technique of inventory control is planned to avoid both hoarding and premature buying which have caused considerable difficulty with some commodities.

Engineer Training—The Office of Education is making plans for a greatly enlarged program of emergency training in college-grade engineering courses. This E.D.T. (Engineer Defense Training) plan provides both for pre-employment courses and for training of men after engagement in the defense industries. The latter program frequently results in important upgrading of technical men in jobs for which they are not otherwise readily prepared. Employers who need such educational assistance should describe their problem either to the Office of Education or to the dean of some nearby engineering school who will help them with the full facilities of his institution.

Borax Priorities—Borax and boric acid are the first chemicals to come under full priority control. Effective June 9, direct military requirements receive a preference rating of A-8 or first call on available supplies. Manufacturers of borosilicate glass are rated at A-9, so these demands are put ahead of other requirements pending the temporary shortage.

Cancellation Bonus—A significant item is included in one American Smelting and Refining Company contract with the government. This provides that Metals Reserve Co. may terminate the contract for 50,000 tons of zinc if it desires during the delivery period by payment of 2⅛ cents per pound for all metal for which delivery has not been made up to the time of settlement. This provision in the nature of a liquidation clause permits the fixing of a price for the zinc, 7.25 cents per pound, at a lower cost to the government than would be necessary if the Company was not to be protected against unexpected cancellation of its contract. Such a businesslike deal is possible with the R.F.C. subsidiary involved, but usually is not considered possible on other direct contracts, as with the Army and Navy.

POTATO STARCH PRODUCTION TO START IN BRITISH COLUMBIA

Establishment of a plant to manufacture starch and glucose from surplus potatoes, in New Westminster, British Columbia, this fall, was announced by J. Lifszyc, a former director of European starch factories, at a meeting of potato growers at Milner, B. C., recently. Mr. Lifszyc stated he is a member of a family which has been in the starch manufacturing business for several generations and they possess secret processes.

He explained that his company has all the finances necessary to operate a plant to handle up to 12,000 tons of potatoes annually. All they require is a continuous supply for which they will pay from $8 to $10 per ton. Construction of the plant will commence in October as delay is being experienced in securing machinery. The plant will operate six days a week for nine months of the year. Potatoes required must contain from 20 to 22 per cent dry matter. He pointed out that this plant could manufacture 2,000 tons of starch or equal to the requirements of British Columbia.

COMMERCIAL SOLVENTS HOLDS ANNIVERSARY CELEBRATION

The twenty-first birthday anniversary of Commercial Solvents Corp. was celebrated May 8, with a dinner-dance held at Terre Haute, Ind., where the parent plant is located. Over six hundred were in attendance including executives from the New York office and from the other plants of the corporation which are located at Peoria, Ill.; Harvey, La.; Westwego, La.; and Agnew, Calif. Henry E. Perry, vice-president, acted as toastmaster and Major T. P. Walker, president, delivered an interesting address.

The featured event of the evening was the surprise announcement of the formation of the "Twenty Year Club." Maynard C. Wheeler, production manager, presented the thirty-five candidates and Major Walker gave to each one a handsome gold watch suitably inscribed to commemorate the occasion.

SHIPMENTS OF ALUMINUM SALTS MAKE NEW RECORD

Aluminum salts shipped in 1940 exceeded those in the previous peak year of 1939 by 4 percent in quantity and 9 percent in value, according to the Bureau of Mines. Producers reported the shipment of 513,520 short tons valued at $12,882,578 compared with 494,032 tons valued at $11,813,299 in 1939. Shipments of aluminum sulphate, the principal product of the aluminum salts industry, totaled 463,799 tons in 1940 compared with 443,029 in 1939 and 374,248 in 1938, denoting an increase in 1940 of 5 and 24 percent, respectively. Sales of aluminum chloride advanced 22 percent over those in the previous year. Shipments of alumina in 1940, excluding that used by the aluminum industry, increased 9 percent in quantity and 26 percent in value over 1939.

Aluminum salts and alumina manufacturers reported the consumption of approximately 189,000 long tons of dried bauxite, 8,047 short tons of alumina, 2,076 tons of aluminum metal, and a quantity of clay, alunite, beryl and chromite residue. It should be noted that of the alumina shipped in 1940, about 31 percent was used in the manufacture of aluminum salts, chiefly iron-free aluminum sulphate, aluminum chloride, and sodium aluminate. About 61 percent of the bauxite used by the chemical industry was domestic.

RECORD FOR SALT PRODUCTION LAST YEAR

Domestic production of salt hit a new high last year according to reports from the Bureau of Mines. The output reached a total of 10,003,448 short tons valued at $26,118,107 as compared with 9,277,911 tons valued at $24,509,680 in 1939. The 1940 production came from 83 plants of 66 companies in 13 States and also included Puerto Rico production. Fully 50 percent of annual production is used in manufacturing chemicals and at least another 25 percent for other industrial purposes.

Preliminary figures of the Bureau of Mines show that new records were established for production and sales of cadmium. Production of metallic cadmium was reported at 6,101,000 lb. or a gain of 38 percent over the 1939 figure. Apparent consumption—metal and in compounds—is estimated at 6,900,000 lb. with the cadmium content of the compounds estimated at 785,000 lb. or 16 percent higher than in 1939. Compounds produced included lithopone, oxide, sulphide, sulphate, and hydrate.

MANUFACTURING CHEMISTS HOLD ANNUAL MEETING

The 69th annual meeting of the Manufacturing Chemists' Association was held at Skytop Lodge, Skytop, Pa. on June 5-6. At the business session the present officers were reelected for the ensuing year. They are, Lammot duPont, E. I. duPont de Nemours & Co., president; George W. Merck, Merck & Co. and Charles Belknap, Monsanto Chemical Co., vice-presidents; J. W. McLaughlin, Carbide & Carbon Chemicals Corp., treasurer; and Warren N. Watson, secretary.

Speakers who discussed the national defense with reference to the chemical industry included Brig. Gen. C. T. Harris, Jr., Lt. Col. J. P. Harris, Maj. C. V. Morgan, and Dr. H. E. Howe. The Synthetic Organic Chemical Manufacturers Association was host at the union dinner.

Byproducts Obtained from Coke-Oven Operations in the United States in 1940[1]

(Exclusive of screenings or breeze)

Product	Production	Sales: Quantity	Sales: Value, Total	Sales: Value, Average
Tar ..... gal.	673,286,517	350,691,110	$16,051,496	$0.046
Ammonia:				
Sulfate ..... lb.	1,436,462,003	1,453,008,364	17,876,168	.012
Ammonia liquor (NH_3 content) ..... lb.	56,938,798	56,249,546	1,798,109	.032
	.....	.....	19,674,277	.....
Sulfate equivalent of all forms ..... lb.	1,664,217,195	1,678,006,548	.....	.....
Gas:				
Used under boilers, etc. ..... M cu. ft.	[2]833,761,720	36,498,403	2,648,328	.073
Used in steel or affiliated plants ..... M cu. ft.		305,890,735	31,171,675	.102
Distributed through city mains ..... M cu. ft.		151,688,271	43,931,892	.290
Sold for industrial use ..... M cu. ft.		29,563,146	3,650,152	.123
	[2]833,761,720	523,640,555	81,402,047	.155
Light oil and derivatives:				
Crude light oil ..... gal.	[3]215,213,667	10,324,670	829,031	.080
Benzol, crude and refined ..... gal.	31,880,556	31,121,220	3,941,364	1.27
Motor benzol ..... gal.	101,140,079	95,329,911	8,037,526	.084
Toluol, crude and refined ..... gal.	26,406,407	25,918,829	6,282,946	.242
Solvent naptha ..... gal.	5,220,979	4,742,859	754,578	.159
Xylol ..... gal	5,645,993	5,335,574	1,239,603	.232
Other light oil products ..... gal	7,500,617	5,110,041	419,081	.082
	[4]177,794,631	177,883,104	21,504,129	.121
Naphthalene, crude and refined ..... lb.	72,426,443	72,522,476	1,248,051	.017
Tar derivatives:				
Creosote oil, distillate as such ..... gal.	27,150,656	16,798,632	1,832,348	.109
Creosote oil in coal-tar solution ..... gal.	2,449,812	923,766	114,771	.124
Pitch of tar ..... net tons	307,040	1,743	11,641	6.679
Other tar derivatives	.....	.....	2,298,328	.....
Light carbolic oil ..... gal.	2,431,293	2,399,778	215,865	.090
Phenol ..... gal.	82,045	71,340	29,130	.408
Pyridine, crude and refined ..... gal.	241,075	218,165	296,441	1.359
Sodium phenolate ..... gal.	168,285	168,287	13,528	.080
Other products[5]	.....	.....	389,825	.....
Value of all byproducts sold	.....	.....	[6]$145,081,877	.....

(1) Includes products of tar distillation conducted by coke-oven operators under same corporate name, except, however, phenol and other tar acids produced at Clairton, Pennsylvania. (2) Includes gas wasted and gas used for heating ovens. (3) Refined on premises to make the derived products shown: 207,272,848 gallons. (4) Total gallons of derived products. (5) Ammonia thiocyanate, asphalt paint, cyanogen, sodium carbolate, sodium prussiate, spent soda solution, sulfur, vented vapors, and a small amount of miscellaneous products. (6) Exclusive of value of breeze production, which in 1940 amounted to $8,472,114.

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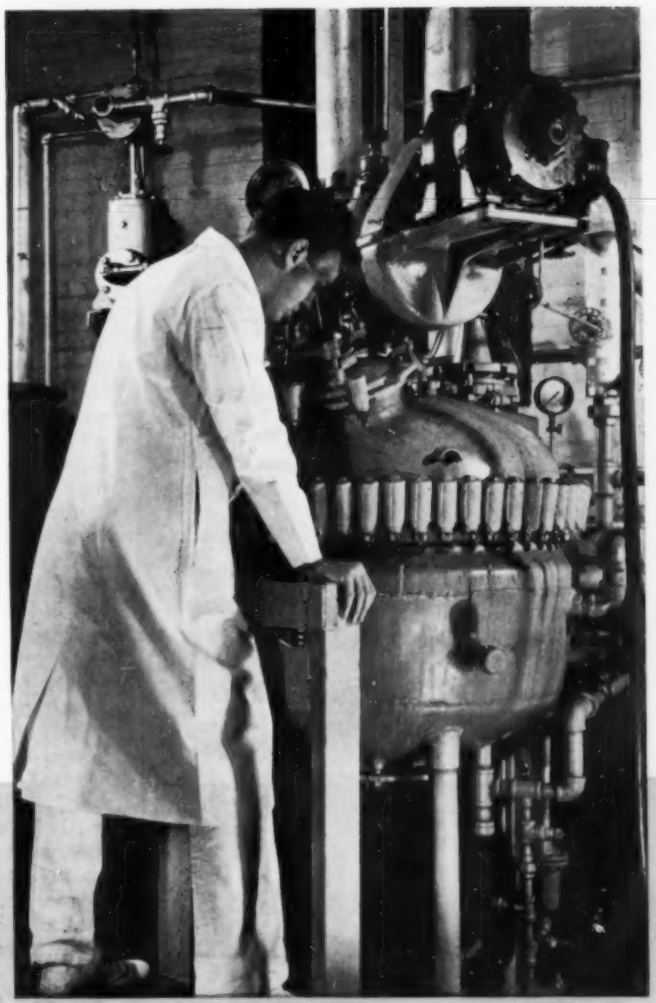

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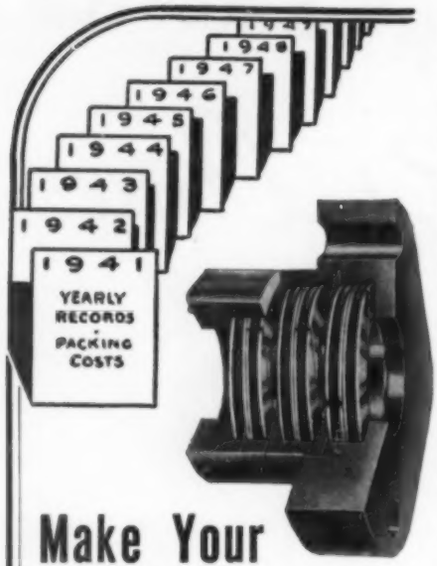

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Special Correspondence

NUTRITION chemistry has become increasingly important since the Reich embarked on its self-sufficiency program and especially since the war cut Germany off from many sources of food supply. Realizing that malnutrition was a significant factor in the breakdown of German civilian and military morale in the World War, scientific institutes and industries, under government direction, have been working to overcome national diet deficiencies and to prevent a similar breakdown. Just as the blockades of the Napoleonic wars stimulated the development on the continent of beet sugar as a substitute for overseas cane sugar, and the World War gave an impetus to perfecting synthetics such as nitrates and rayon, the present war has furthered development of food substitutes utilizing the most recent knowledge of vitamins and nutrition.

Work in the nutritional chemistry field has been carried out at practically all of the 68 university and college institutes as well as in industry. Among present prominent German biochemists are Dr. Windaus, director of the chemical institute of the University of Goettingen, known in the Reich as the discoverer of anti-racchitic vitamin D and synthesizer of Vitamin B1; Dr. A. R. Kuhn, director of the Kaiser Wilhelm Institute for Medical Research at Heidelberg, whose analyses of organic pigments and enzymes made possible the subsequent synthesis of such vitamins as A, B2, and B6; and Dr. H. Wieland, director of the chemical institute of the University of Munich, known for his work in enzyme chemistry and the chemistry of steroles.

Cooperating with the institutes and carrying on research of their own, pharmaceutical divisions of Reich chemical concerns have been producing increasing amounts of vitamin tablets which have been distributed free on a large scale to school children of the Reich and occupied countries and to adults in some of the larger population centers. Tablets developed by a physician, Dr. Morell, containing chiefly vitamins B and C have recently been distributed to metal and other heavy duty workers to boost their vitality in the spring months when fresh vegetables are not available. Successful experimentation to increase the fat content of milk through adding vitamin B1 and B2 in suitable form to fodder is reported in the "Klinische Wochenschrift." By supplying yeast, betabian, and lactoflavin to the cows the average fat content of their milk increased from 3.2 to 3.6 percent, a relative rise of 13 percent, without a decline in the total milk yield. If such feeding were widely carried out, it would help to reduce northern Europe's milk and butter shortages, which are still severe despite improvement recently.

Production of margarine through adding refined and hardened plant oils to animal fats goes back in Germany to the 80's of the last century. Recently margarine made entirely of plant oils, such as rape seed oil, is being produced and marketed in half-pound cakes. That margarine has not been entirely satisfactory as a butter substitute is indicated in a recent government decree which requires that a concentrate of vitamin A be added to all foods consumed in place of animal fats and butter. The concentrate, obtained from whale- and fish-liver, must first be deodorized and disagreeable flavor removed before it can be used to fortify other foods. Similarly, in Norway, herring oil, from which the taste has been removed, is used in larger quantities to replace olive oil.

Since the animal fat problem in northern Europe is largely a question of insufficient cattle fodder, the Bergin Holzhydrolyse company, with government subsidy, has been experimenting to develop a suitable protein cattle fodder in connection with wood sugarization processes. Similar work also has been carried on in Sweden and Finland, countries also short in fodder, but rich in forests. A recent announcement that eight cellulose fodder factories are to be erected in Germany indicates that this substitute fodder will be used on a large scale. Manufactured from chemical wood pulp as Herbst "cell flour" or in cheaper rolled dry form under the Liebsch process, and mixed with egg white, oats, molasses, and carbonic calcium, in experimental feeding the fodder has been supplied to horses at the rate of 4 kg. per day. It is claimed that horses eating it had no digestive trouble nor loss of weight or energy. It is planned to use it for feeding cattle as well as horses.

The Reich's utilization of processes requiring growing amounts of cellulose has become possible only with requisitioning of timber from occupied territories and increasing imports from Scandinavian countries. In the past four years, consumption of wood for cellulose in the Reich has more than doubled as the paper, rayon, and cell wool industries have stepped up outputs. To get around the necessity of imports as well as to utilize available beech wood supplies, consumption of beech wood has been pushed from 500,000 cubic meters in the forest year 1937-8 to an estimated 2,400,000 meters during the current year, which is in accordance with the goal set up by the Reich's Four Year plan in 1936. Dur-

ing the same period consumption of pine timber for chemical pulp increased only from 1,300,000 cubic meters to an estimated 1,900,000 cubic meters. Since processes able to use inferior woods have been developed, the government hopes to increase cellulose production by promoting cultivation of more quick-growing poplar trees and certain pine, birch, and ash trees.

To supplement wood cellulose, increasing amounts of other cellulose sources are being tapped. Straw cellulose production in the old Reich has risen from 52,000 tons in 1936 to 77,000 metric tons in 1939, while use of yellow straw for cardboard and paper increased from 87,000 to 103,000 tons in the same interval. To utilize Holland's excess straw, the Dutch "Aku" rayon combine, with the German Vereinigte Glanzstoffe and Phrix concerns, has recently undertaken production of cell wool from straw at Arnhem. Holland in 1938 had 2.5 million tons of straw, of which only 200,000 tons were used domestically for carton fabrication, while the rest was exported. France, which heretofore has had only a slight production of cellulose from wood, and that in a few plants in southern France processing spruce and chestnut woods, is now reported to be making plans for extensive cellulose production from straw.

That some of the new dramatically announced raw materials are not always up to immediate expectations is indicated by the admission in the *Chemische Fabrik* that first attempts to obtain bast fibers for textiles from fresh potato tops have not been economic because of a fiber yield of only 1.6 percent. The potato vine cellulose structure differs from that of straw and wood, although it is somewhat like that of beech cellulose. It has been found, however, that with pre-drying and other treatment, the cellulose content can be concentrated so that it is suitable for paper manufacture. Potato tops are, therefore, being gathered under direction of the central potato growing and distributing organization (Hauptvereinigung der Kartoffelwritschaft) and are being pressed into briquettes for manufacture of paper by the Schwarza cellulose and the Croellwitz paper factories. Because of the strength and whiteness of the fiber, it is claimed a good type of paper can be made, either on the basis of potato fiber alone or in mixture with straw cellulose. Whole newspapers and publications are already being printed on the so-called "Solanum" paper (from solanum tuberosum, botanical name for potatoes). Since Germany is a large potato producing country it is hoped to develop a feasible process to divert potato cellulose so that it may find use in the textile industry.

In addition to using wheat- and rye-straw for cellulose wool, coarse hemp-like textile fibers from hop vines already have saved an estimated 50,000 cubic meters of cellulose wood, according to an official statement. It is claimed that an economical process

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SPREADING discomfort — sapping vitality — slowing up production. Heat-Fag does its work quietly — unseen — *whenever men sweat.* For, sweating robs the body of its normal salt balance — and, doctors tell us that lowered efficiency, fatigue, discomfort follow — even sickness or cramps in extreme cases.

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has been developed to turn out an odorless, non-creasing product stronger than natural hemp.

"Cell jute" is the first successful synthetic hard fiber produced in Germany, according to a statement in *Angewandte Chemie.* The synthetic fibers is claimed to be more elastic, more uniform, and cleaner than natural jute. Cell jute is used to manufacture sacks for flour and sugar and for coverings for cell wool. It has also found important uses in the linoleum, cable and carpet industry. Another jute substitute, a "Spinnpapier" is being made into sacks. It is estimated that 200,000 to 300,000 tons of waste paper are used yearly to be spun into these containers.

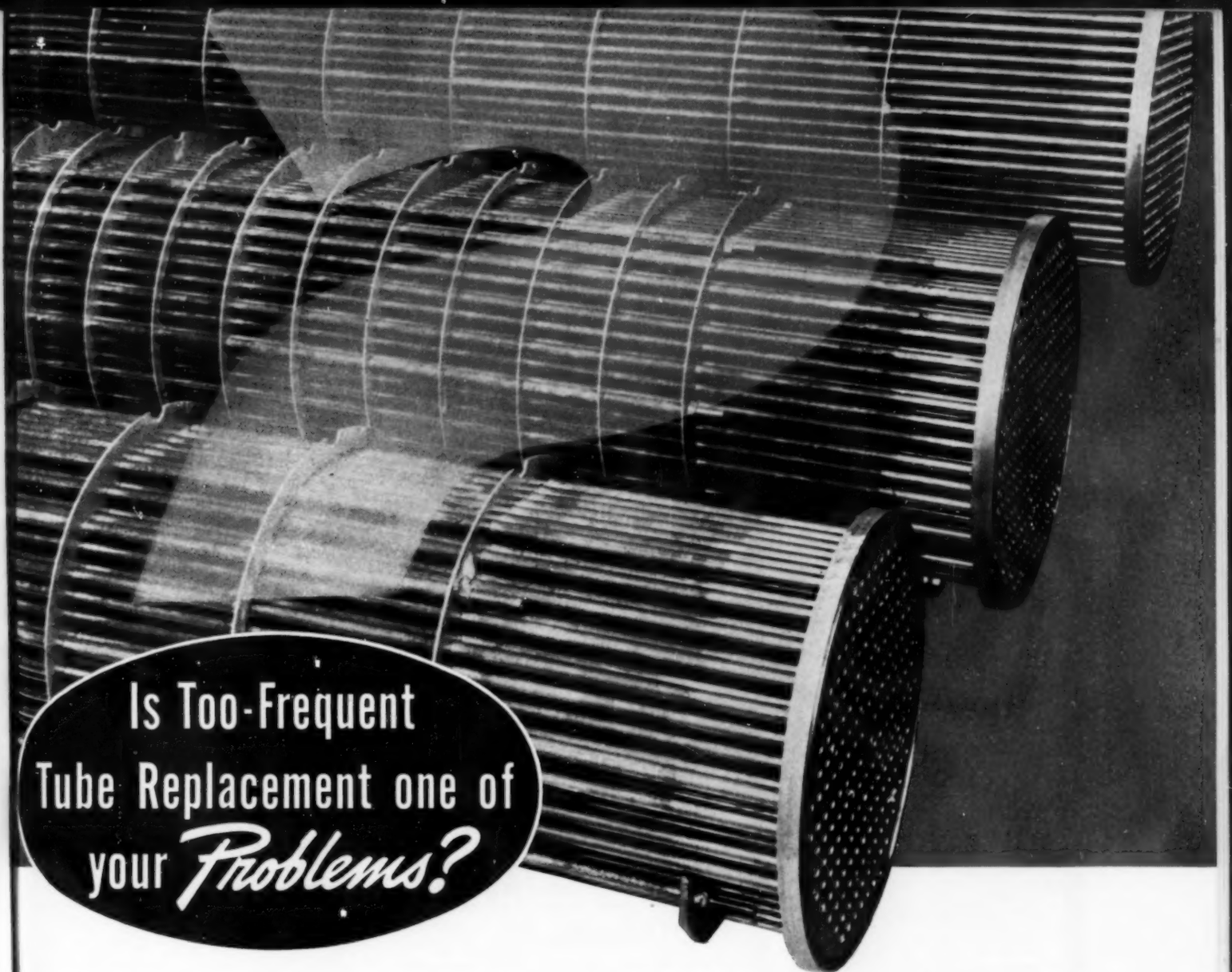
Paper is also used to replace cork as an insulating material in a product developed in Sweden. Marketed under the trade name "Wellit," the new product, which is claimed to be cheaper than cork and almost as satisfactory as an insulator in houses and refrigeration, is made of slabs of special kraft paper, impregnated to render it impermeable to moisture.

With so many new substitutes coming on the market, a recent decree provides that all substitute and new products, domestic or imported, must be registered with the price control office, giving a statement of manufacturing costs, intended prices, uses, and composition.

Of importance is the development of a substitute for tincture of iodine, marketed as "Iodana" tincture. It consists of complex bromine iron rhodanides and methylated halogen phenols in a 10 percent alcohol solution. Its germ-killing effect is said to be almost equal to that of iodine, and in the concentration available it is claimed to be chemically stable and not to irritate the skin. New sulphanilamides which are claimed to eliminate undesired side reactions of sulphapyridon such as cyanosis and uremia are reported to have been successfully used at the Kiel University clinic. They are chiefly 2—methyl-, ethyl-, isobutyl compounds of the 5 (p-aminobenzol sulfonamido)—thiodiazo group.

A decree to protect against ill-effects from new products prohibits the use of cadmium and its alloys in the manufacture of utensils coming in direct contact with foods. Soluble cadmium salts released in contacts with some acid foods were reported to produce poisons approaching mercury and arsenic in strength.

Care also has to be exercised in connection with changes in packing materials since use of tin plate for cans and containers was forbidden at the outbreak of the war. Cans made of black iron sheet, which so far cannot be successfully soldered, have to be impregnated to protect the contents. Some improvements in quality of the black iron sheet and impregnation are already reported. Eventually, it is assumed that aluminum will largely replace tin in production of containers and thus reduce tin requirements.



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Republic ELECTRUNITE Stainless Steel Tubing is made in popular analyses, in sizes from ¼ to 3-inch O.D., and in various gauges. Use it in a piece of equipment that is high in tube replacement cost—and see what it will save. For further information, write Steel and Tubes Division, Republic Steel Corp., Cleveland, O.

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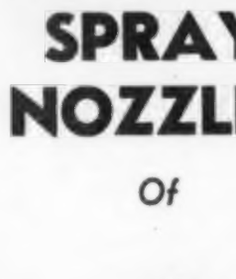
ELECTRUNITE

ELECTRIC RESISTANCE WELDED STAINLESS STEEL TUBING

MONARCH CHEMICAL SPRAY NOZZLES

Of



BRASS:

The Fig. 629 nozzle illustrated is of the "non-clog" type; i.e. it contains no internal vanes, slots, or deflectors which might facilitate clogging.

Available ¼" or ⅜" male pipe connection and ¼" to 1" female pipe. (Fig. 631). Small sizes produce a very fine, soft, wide angle spray at low pressures. Capacities 5.3 g.p.h. up.

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Patented Fig. B-27 nozzle is also of the "non-clog" type, "Hollow" cone spray. Available ¼" to 1" pipe.

Fig. 621-A for capacities as low as 2.5 g.p.h. Larger capacities may be had in "solid" cone spray, ¼" ⅜", and ½" pipe.

Fig. H-407 "flat" spray produces a relatively fine even sheet of liquid. ¼" and ½" pipe.

Write for Catalogs 6A and 6C

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READERS' VIEWS AND COMMENTS

Readers are invited to express their views on articles appearing in Chem. & Met. *or on other subjects of interest to chemical engineers. As far as our space permits such views and comments will be published in these columns. Address your letter to the Editor of* Chem. & Met., *330 West 42 St., New York, N. Y.*

Editor's Note: This is the time of year when lots of us are being asked for advice — new men fresh out of college, juniors in our own plants, even high school seniors that want to know what it takes to make a successful career in chemical engineering. The following letter was written at our request by a designer of chemical engineering equipment. If you have had some experiences and have some words of advice to share with our younger *Chem. & Met.* readers, here's your chance.

ON GETTING AHEAD

To the Editor of Chem. & Met.:

Sir: — After racking my brains at odd moments in an endeavor to dig up, at your suggestion, various and sundry "trials and tribulations" of a chemical engineering designer, I got to rambling and soon found I couldn't stop within the confines of a self-respecting letter. I don't know what you would call the resulting spiel, but for want of a better title I call it:

So You Want to be a Designer

Let us first consider what are the attributes of a good designer. No matter what the field, he must be, first and foremost, gifted with imagination. To a very high degree he must develop good judgment so that the various ideas which must evolve may be correctly and rapidly evaluated. Added to these are the more general requirements and acquirements, all of which are necessary to a greater or less extent no matter what the profession, and which include specific knowledge of a given field.

I am a designer and I must have ideas — big and little, goofy and not goofy. If I can't get ideas I am out of luck. That's not so bad generally speaking, but the rub is that I must handle a series of specific problems in designing any given unit or assembly and I must produce at least one practical solution for each problem, preferably several. And sometimes the ratio of impractical to practical ideas is surprisingly high. I must be able, first, to analyze the problem at hand and, second, to analyze and evaluate the various solutions which present themselves.

Suppose we digress a bit about this matter of imagination. All individuals are not apparently so gifted — perhaps some other term than "gifted" would be more appropriate, for at times an active imagination can be anything but a "gift." To how great an extent imagination can be acquired is problematical. Oddly enough perhaps, imagination is generally more active during the earlier part of life, particularly so in childhood. This may be due to the fact that self-control nominally increases with age and one's imagination is often repressed in the process. Naturally a designer must be able to control his imagination.

And so I will venture to say that because ideas are the product of imagination, it is of the utmost importance that imagination must be in no sense repressed. True, imagination is of no value if not properly harnessed and directed, but guidance and direction are of no value if the result is repression. In many cases, young men gifted with imagination are so "sat upon" as the result of the inevitable wild ideas which are evolved at times that repression of this faculty results. The more so in that these persons are often quite sensitive. On the other hand, those gifted with imagination frequently react well to sensible guidance. And a bit of consideration on the superior's part is likely to pay real dividends.

I, along with many another, have sufficient imagination — or I think I have — then what must one do to become a good designer? It seems to me that one must acquire a general knowledge of his chosen field of endeavor, in some limited part of which he may eventually become truly expert. Further, and infinitely more difficult to accomplish, one must endeavor to acquire and develop to a high degree that elusive faculty called judgment. A designer must be able to act as an impartial judge of his own ideas, comparing them justly with each other and, harder yet, with those advanced by others. Certainly good judgment is valuable in all fields of endeavor, but in design work one must make frequent rapid decisions where mistakes would be costly. A qualification must be made here in that the fields of design are many and varied and speed is possibly not always important, but it certainly is in most cases in the chemical equipment game.

This attainment of good judgment is, then, very essential — how can it be achieved? It's a long, slow business. Perhaps some few are born with it — certainly I wasn't. It seems, rather, that judgment is generally secured gradually and demands close, careful observation of the whys and the wherefores. So judgment is a brother to learning — it may be said to be that which makes learning make sense. Anyway, it can be gained by close observation of the passing tide and logical deduction therefrom. Close observation is not so difficult but logical deduction certainly is. Logic and judgment are somewhat akin, but I would say that judgment stems from logic.

Knowledge you must have, but that knowledge must be classified, directed

and controlled so that you may obtain due benefit therefrom. It is not unreasonable to state that the application of knowledge can itself be studied and cultivated, and indeed judgment may be called the logical application of knowledge. We also call it common sense, though why the "common" nobody knows.

It is well to bear in mind at all times that good judgment in itself demands to a high degree coolness and impartiality in all respects. One cannot allow himself to get rattled or to become prejudiced. One must strive for self-control. When quick decisions are necessary, it is essential to remain open-minded; because you did something one way once or many times, must not mean that some other way won't be better next time. But don't change something just for the sake of changing it.

I have said that judgment is generally secured gradually and there is probably little argument on this score. I have also said, moreover, that judgment can be cultivated and developed. If this be true, most of the present day educational institutions are somewhat deficient. It does not seem logical that logic and judgment should not be taught, at least to some degree, in the higher educational institutions. This is not the time for a dissertation regarding the human failings of our schools and colleges, but this question is in itself worth pondering.

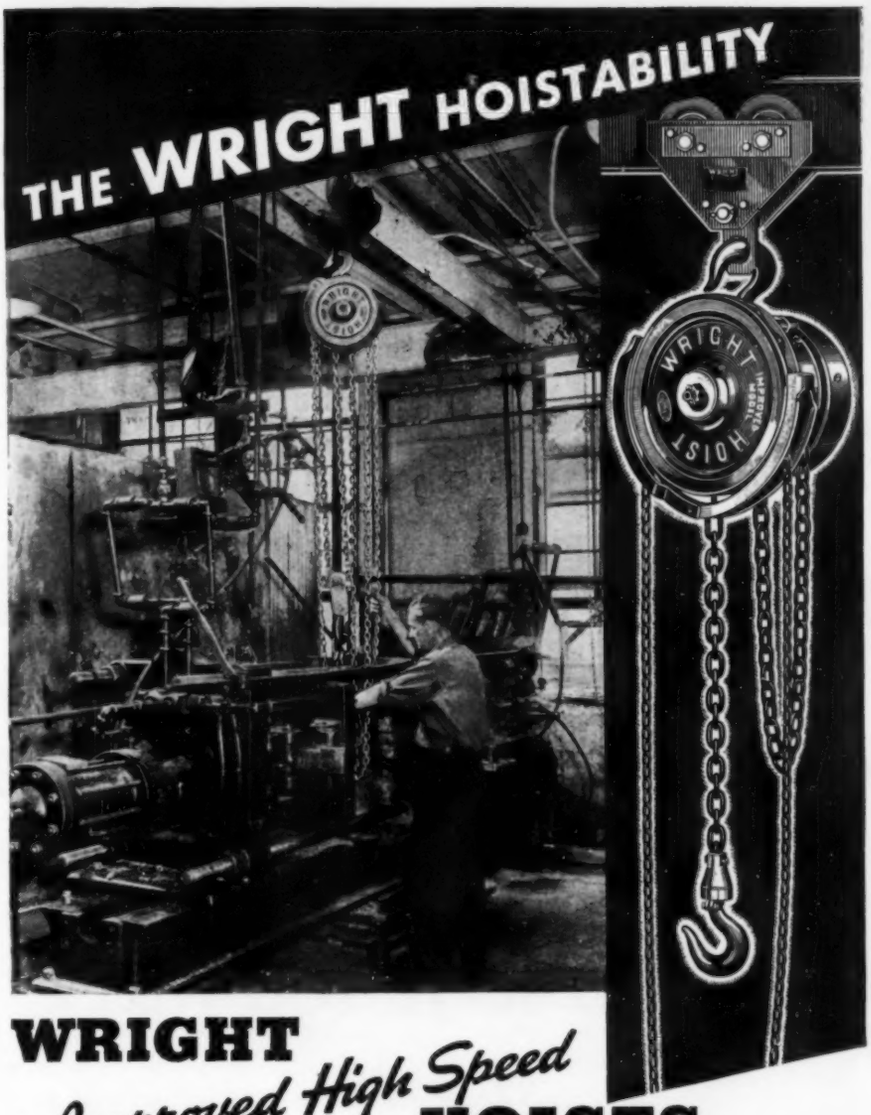
To get back a little closer to homeplate, I went through the mill in chemical engineering and decided to become an equipment designer. Why? Because in my senior year we had to submit a design thesis which I found highly interesting.

On looking back it requires no great perception to see that the greater part of what troubles I have had in my profession — and elsewhere — have been due to my own very marked lack of "savvy" — the knack of getting along with people. Incidentally, most if not all, technical schools certainly fail sadly in this respect. There is no question but that this also can be taught, being based mainly upon a sincere consideration of other persons and their viewpoints. Technical courses are generally intense in nature and such an antidote would be of great value. Although this is undoubtedly a very important segment of everyone's experience both in and out of his profession, my personal experiences in this regard probably would not be of interest.

Remember the old saying that goes something like this: "He has eyes and he sees not, he has ears and he hears not, and he knows this not." It is indeed good to be able to concentrate when need be, but don't get to be like the absent-minded professor of fame and story.

It's a long, long way to go my friend, but it's interesting and worthwhile — so good luck to you!

HALE D. SEYMOUR
Chemical Engineer
Mt. Vernon, Ill.



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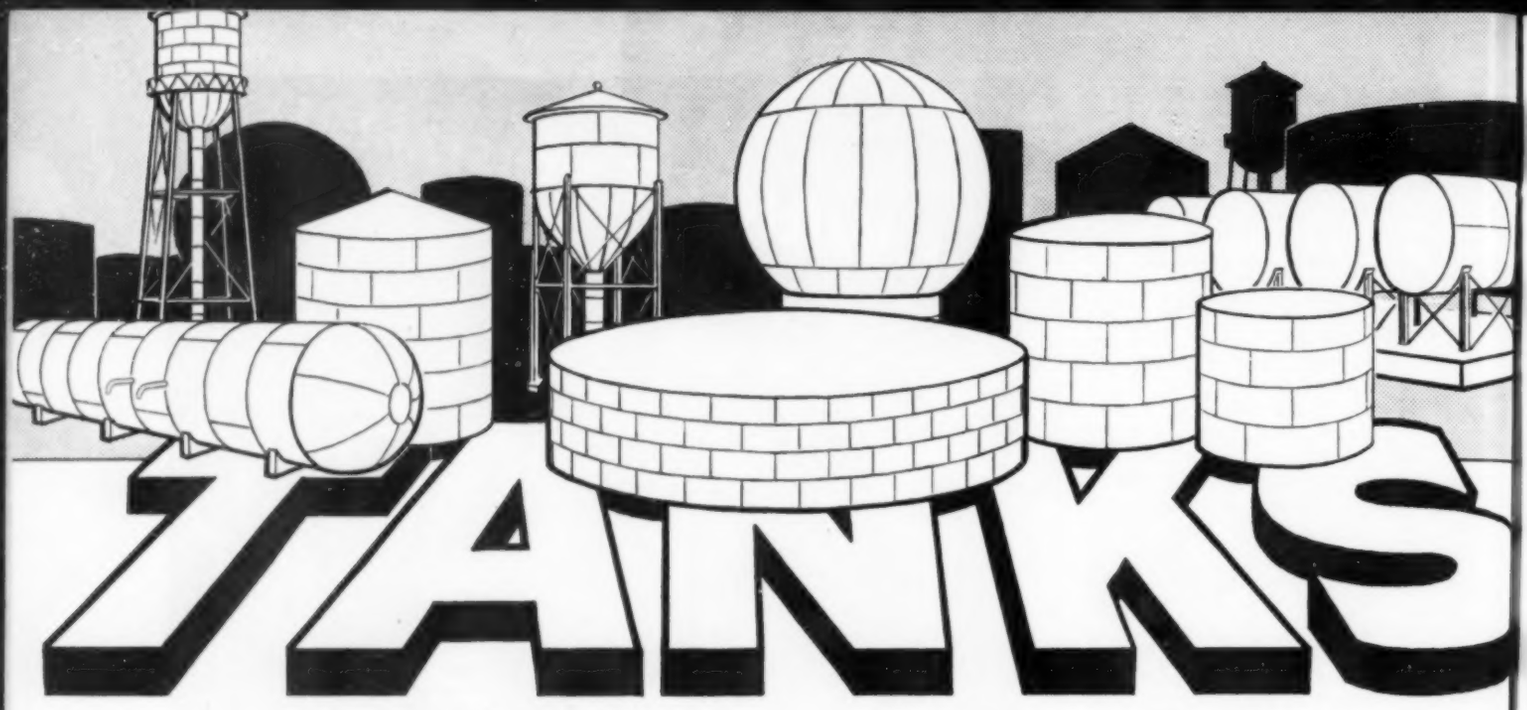

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PERSONALITIES

Harris & Ewing

William N. Porter

C. F. Rassweiler

✦ WILLIAM N. PORTER is the new chief of the Chemical Warfare Service. Major General Porter was born Mar. 15, 1886 in Ohio. He was transferred to the Chemical Warfare Service in 1921 and has just been appointed its head to succeed General Baker who recently retired.

✦ WALTER C. BAKER, chief of the Chemical Warfare Service, retired from active duty upon his own application on April 30. General Baker's four-year term of office as chief of the service would have expired on May 24. His successor is General William N. Porter. General Baker served at various coast artillery stations throughout the United States and in Hawaii prior to the World War. He was transferred from the Coast Artillery Corps to the Chemical Warfare Service in 1920, subsequently serving in the office of the Under-Secretary of War and as Commandant of the Chemical Warfare School. He was appointed chief of the Chemical Warfare Service on May 24, 1937.

✦ ROBERT A. KRAMER, manager of the chemical department of the Th. Goldschmidt Corp., New York, has resigned from that company to assume the position of sales manager of Evans Chemetics, Inc., of New York. Mr. Kramer had been associated with the Goldschmidt organization since 1926 and since 1929 had been secretary of the company as well as manager of the chemical department.

✦ G. L. CUNNINGHAM has been appointed manager of the Technical Service Department, Columbia Chemical Division, Pittsburgh Plate Glass Co., Dr. Cunningham joined the Pittsburgh organization in September of last year, after having served as research chemist for the Mathieson Alkali Works since 1930.

✦ C. F. RASSWEILER has been appointed director of research of Johns-Manville Corp. by Lewis H. Brown, president of the corporation. Dr. Rassweiler has been director of the Philadelphia laboratory of E. I. duPont de Nemours & Co. In his new position Dr. Rassweiler will be a member of the Officers Board in charge of Johns-Manville's extensive research activities on which the company has been spending close to a million dollars annually. Born in Polo, Ill., Dr. Rassweiler was graduated with the Bachelor of Science degree in chemistry from the University of Denver in 1920. He secured his Master's degree from the University of Illinois in 1922, and his Ph.D. from the same institution in 1924. He joined the duPont organization in that year as a research chemist and since 1932 he has been director of the laboratory in Philadelphia.

✦ W. L. ABRAMOWITZ has resigned from the National Oil Products Co. at Newark, N. J. to become a member of the newly organized firm of Industrial Inventions, Inc., at Peabody, Mass.

✦ WILLIS H. CARRIER, chairman of the board of the Carrier Corp., Syracuse, N. Y., was awarded the Frank P. Brown medal for improvements in the building and allied industries by Franklin Institute of Philadelphia. The award was made to Dr. Carrier as a pioneer in the creation and development of the science of air conditioning. A graduate of Cornell University in 1901, one of Dr. Carrier's first jobs was in problems of control of temperature and humidity. It was during this period that he conceived the need for air conditioning and started experiments which resulted in his Rational Psychometric Formulae in 1911. In 1915 with J. Irvine Lyle and others, many of whom are still associated with him, Dr. Carrier founded the Corporation bearing his name.

✦ ALBERT B. NEWMAN, acting dean of the City College School of Engineering, has been appointed regional director of the United States Office of Education's engineering defense training program, it was recently announced. He succeeds Joseph W. Baker, former dean of the Columbia University School of Engineering, who has received a full-time appointment with the Navy Department in Washington.

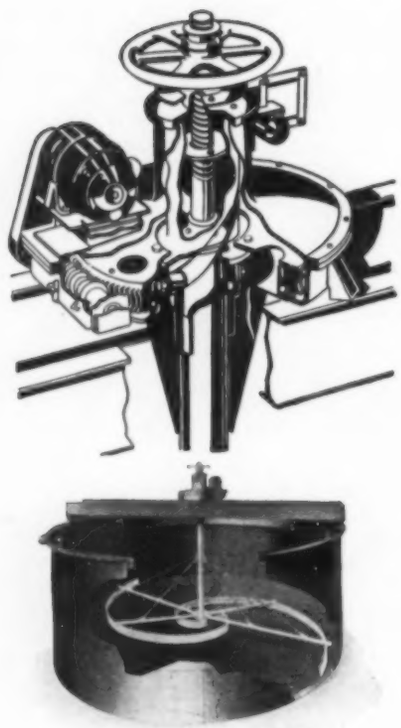
✦ RALPH L. ERICSSON has been added to the staff of the Trade Relations Division of Commercial Solvents Corp. His activities in his new position will be chiefly concerned with advertising and sales promotion. Mr. Ericsson is a graduate of Carnegie Institute of Technology and was formerly employed in the Technical Service Division of Warner Chemical Co.

✦ R. B. HIGH has been appointed special Washington representative for Shell Union Oil Corp. and its affiliated companies. He is a graduate engineer of the University of California and supervised the construction of the majority of Shell's refineries in the United States, and has been operating manager of three of them. For the past two years he has been vice president of the Shell Pipe Line Corp. whose system of pipe lines carries crude oil out of the fields of Texas, Oklahoma and Kansas to company's refineries at Houston, Tex. and Wood River, Ill.

✦ LELAND H. GRENELL has been engaged by Battelle Memorial Institute, Columbus, Ohio, for research and development work in the rapidly growing new products research of the Institute. An important part of the immediate program in this field is the development of improved alloys of copper for industrial application. Mr. Grenell is a graduate in metallurgical engineering of the Pennsylvania State College. He was a member of the staff of the U. S. Bureau of Mines and the National Bureau of Standards; for the past five years he has been engaged in process engineering and material development for the Frigidaire Division of the General Motors Corp.

✦ E. BRUCE POWELL, a senior at the Clarkson College of Technology, Potsdam, N. Y., has been awarded first prize in the annual problem contest conducted by the American Institute of Chemical Engineers among its student chapters. Second prize was won by Weller R. Pierce, also of the Clark-

"AUTO RAISE"
THICKENER



The Hardinge "Auto-Raise" Thickener Mechanism literally lifts the scrapers away from obstructions or extra heavy load in the tank bottom. It rotates on oil submerged ball bearings in a weather proof housing.

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son College of Technology Student Chapter. Third prize went to Sidney M. Feldman of the College of the City of New York.

✦ HOWARD H. MCCLURE has been promoted to be assistant director of the Bureau of the Census in charge of the current statistical activities. A considerable portion of the Bureau of Foreign and Domestic Commerce activity on foreign trade statistics and the F. & D. C. customs unit at New York City were transferred to his supervision, effective May 1. This centralizes statistics on all chemical and industrial materials in a single Commerce Department unit. There will be, however, close cooperation between the two Bureaus on trade matters which have mutual interest.

ROBERT R. COLE

✦ ROBERT RAST COLE of Anniston, Ala., has been elected a vice president of Monsanto Chemical Co. Mr. Cole is general manager of Monsanto's phosphate division which has plants in Monsanto, Tenn., Anniston, Ala. and Carondelet, Mo. and a fourth plant under construction at Trenton, Mich. He was born in Pensacola, Fla., November 1890; after graduation from technical high school in Columbus, Ga., he taught mechanical engineering in the same school for a year and then took a special course in mechanical engineering at Cornell University. In 1920 he became general superintendent of the Southern Manganese Corp., later the Swann Corp. which position with other titles he held until 1932 except for 1928 and 1929 which he spent in France constructing a plant for Societe Phosphates de Tunisiens. When Swann was absorbed by Monsanto in May, 1935, Mr. Cole became assistant to the late R. J. Horn, vice president. In November, 1938 he was made production manager of the phosphate division and in May, 1939, general manager in charge of the divisions' research sales activities as well as manufacturing operations.

✦ JAMES COOMBE was recently elected president of the Wm. Powell Co.,

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Upper Right: Assembled type "Dustube" Dust Collector.

Above: Knocked-Down Type "Dustube" Dust Collector.

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manufacturers of corrosion resistant valves. With the exception of 2½ years, during which time he served overseas, as captain of artillery in the first World War, he has been associated with the company since his graduation from Yale in 1910 .

✦ SCHUYLER HERRES has been awarded an appointment as research associate in the Research Education Division of Battelle Memorial Institute, Columbus, Ohio.

✦ H. F. WYMAN, after an absence of two years, has returned as plant superintendent of Alloy Fabricators, Inc., Perth Amboy, N. J.

✦ E. J. HERGENROETHER, formerly metallurgist in the Development and Research Division of the International Nickel Co., has been appointed to the staff of the Conservation Section, Production Division of the Office of Production Management.

✦ ARTHUR W. BURWELL, technical director of the Alox Corp., Niagara Falls, N. Y. has been awarded the Jacob F. Schoellkopf gold medal of the Western New York Section of the American Chemical Society. Honored for his work in producing and utilizing fatty acids, lactones and other chemicals from petroleum, Dr. Burwell is the eleventh scientist to receive the award, founded in 1931 by Jacob F. Schoellkopf, industrialist and financier, and a member of a pioneer Buffalo family.

✦ V. P. RUMLEY has been elected vice president in charge of manufacturing of the Crane Co., Chicago. He succeeds J. H. Collier who was made president earlier this month. Mr. Rumely has been works manager of the Chicago plant of the company for the past four years.

✦ WALTER J. NELSON, who has been the sugar industry specialist for the Celite Filter-Aid Department of the Johns-Manville Corp., for the past 12 years, has resigned to accept the position of general superintendent of the Imperial Sugar Co. at Sugar Land, Tex. Prior to his joining Johns-Manville, Mr. Nelson was a member of the operating department of the California & Hawaiian Sugar Refining Co. at Crockett, Calif., for seven years. He is a graduate of the Chemical Engineering School of Stanford University.

✦ O. P. CLIPPER has been added to the staff of the Plaskon Co. He has recently resigned from the Glidden Co. to assist in the development of urea-formaldehyde resins for the paint trade with the Plaskon organization. He will be associated with Dr. A. M. Howald of that organization. In joining the Toledo concern, he ends a 13-year period of service with Glidden. He first entered that organization as assistant

WATER FOR THIS BIG PAPER MILL

THE Southland Paper Mills plant at Lufkin, Texas, is the first erected to make newsprint from yellow pine. Typical with the majority of paper mills, Layne Wells and Pumps are used to supply their water needs. Five units provide over 10,000,000 gallons daily.

Layne Wells and Pumps also serve cities, towns, communities, defense plants, army camps, air fields, railroads, packing houses, breweries, chemical plants and a wide range of other industries.

Layne Wells and Pumps are designed, built and installed by the Layne organization. They give longer years of service. Upkeep expense is exceedingly low. Write for latest bulletins, catalogs, etc.

LAYNE & BOWLER, INC.
Memphis, Tenn.

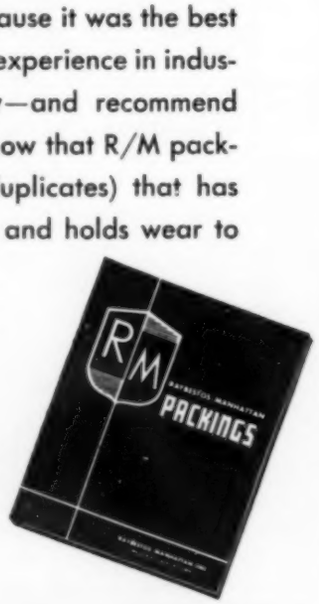
LAYNE
PUMPS & WELL WATER SYSTEMS

AFFILIATED COMPANIES

Layne-Arkansas Co.	Stuttgart, Ark.
Layne-Atlantic Co.	Norfolk, Va.
Layne-Central Co.	Memphis, Tenn.
Layne-Northern Co.	Mishawaka, Ind.
Layne-Louisiana Co.	Lake Charles, La.
Layne-New York Co.	New York City.
Layne-Northwest Co.	Milwaukee, Wis.
Layne-Ohio Co.	Columbus, Ohio.
Layne-Texas Co.	Houston, Texas.
Layne-Western Co.	Kansas City, Mo.
Layne-Western Co. of Minnesota	Minneapolis, Minn.
Layne-Bowler New England Corp.	Boston, Mass.
International Water Supply	London, Ontario, Can.

Why Maintenance Men Acclaim R/M PACKINGS

We like the general approval of Raybestos-Manhattan packings, but the applause we appreciate most comes from the men who know—the boys who are responsible for clean, smooth, economical shop performance. They specified R/M packings in the first place because it was the best known name in asbestos, with 40 years' experience in industrial control. But they specify it now—and recommend it today on pure performance. They know that R/M packings are the complete line (without duplicates) that has smoother control, needs less attention, and holds wear to the absolute minimum. Join them. Let R/M packings whip your power into line. You'll find it pays.



Invitation: Own your personal copy of this complete, condensed, cross-indexed and photographic R/M catalog. You'll pick the right packing in less time, and you'll get quick delivery. Write for a free copy, or ask your nearest R/M distributor.

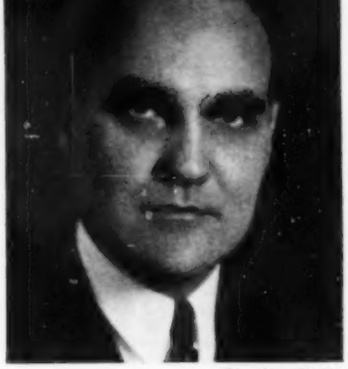
INDUSTRIAL SALES DIVISION
RAYBESTOS-MANHATTAN, INC.
Makers of Packings for Every Industrial Use
BRIDGEPORT, CONN. MANHEIM, PA. NORTH CHARLESTON, S. C. PASSAIC, N. J.

manager of the plant in Chicago. In 1930 he was appointed plant manager. In 1933 he was recalled to the Cleveland office and placed in charge of lacquer operations.

✦ GEORGE PAPPAS is serving one year on active duty as 1st Lieutenant with the 41st Engineers, Fort Bragg, N. C. He is engineering officer of plans and training for the regiment.

✦ EDWARD W. CHAPLIN has changed his headquarters from Jamaica, L. I., to 30 Church St., New York, N. Y. He is at work on a new process for the production of carbon black.

✦ PAUL H. ISENBURG of the Commercial Solvents Corp., has been transferred from the process division of the Peoria plant to the engineering division for all plants at Terre Haute, Ind.



Greystone Studios
Albert E. Forster

Luke H. Sperry

Albert E. Forster, general manager of Naval Stores Department, and Luke H. Sperry, chief engineer, have been elected directors of Hercules Powder Co. Petrus W. Meyeringh has been elected a vice president and member of the Executive Committee. These elections increase the Board to seventeen members.

✦ JESSE J. RICKS, formerly president of Union Carbide and Carbon Corp., was elected chairman of the Board and Benjamin O'Shea, formerly vice president, has become president. James A. Rafferty, a vice president, was elected a director to succeed Matthew J. Carney, resigned. Robert W. White, secretary and treasurer, was made a vice president as well. Both the new chairman and the new president have been with the organization since its formation in 1917.

✦ DONALD PRICE, technical director of the Organic Research Laboratory of the National Oil Products Co., Harrison, N. J., has been elected chairman of the New York Chapter of the American Institute of Chemists for 1941–42. Dr. Elmo Northey of Calco Chemical Co., Bound Brook, N. J., has been elected vice chairman. Dr. Milton Burton is the new secretary-treasurer.

✦ G. E. F. LUNDELL, chief, Chemistry Division, National Bureau of Standards, has been nominated for the presidency of the A.S.T.M.

✦ RALPH H. MULLER, professor of chemistry at New York University, was elected chairman of the New York Section of the A.C.S.

✦ HAROLD URIST has been appointed to the research staff of National Oil Products Co., Nopco Vitamin Laboratories. Dr. Urist is a graduate of the University of Minnesota.

OBITUARY

✦ ALBERT N. BENEDICT, president of the Arlington Chemical Co., died June 4. He was 57 years old.

✦ ARTHUR C. LANGMUIR died May 14 at his home at Hastings-on-Hudson, N. Y. He was 69 years old. Dr. Langmuir founded the American Chemical Society's annual prize of $1,000 given to a young scientist for outstanding research in pure chemistry.

✦ STANLEY WARZALA, supervisor of safety for the Calco Division of American Cyanamid Co. at Bound Brook, N. J., died June 9 in the Somerset Hospital in Somerville, N. J., after a short illness. He was 63 years old.

✦ ALLEN V. POTTER, sales representative for the Speer Carbon Co., Saint Marys, Pa., during the past five years, died suddenly April 25, at the age of 36 years.

✦ MILTON W. ST. JOHN, manager of sales, By-Products, Jones & Laughlin Steel Corp., Pittsburgh, died May 1 after a short illness. He was 52 years of age. After serving in the United States Army during the last World War, he came to Jones & Laughlin in 1919 as manager of sales, By-Products, remaining in that capacity until his death. He was graduated from New York University, School of Chemical Engineering.

Most important point in buying screen

As a user of metallic filter cloth or wire screen, you seek certain definite qualities in the product you buy. Perhaps it's ability to resist corrosion. Or ability to accurately filter or grade material at high capacity. Maybe something entirely different.

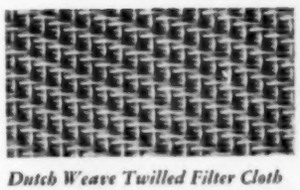
Right here, we believe, manufacturing experience is the most important point of all to keep in mind.

100 years of wire fabricating experience make Roebling especially well equipped to meet your filtering or screening requirements.

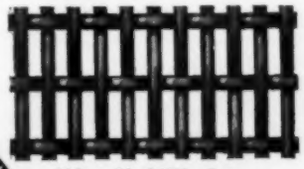
It is an assurance of: (1) highly developed manufacturing methods, (2) correct choice of metals, (3) skillful, accurate weaving.

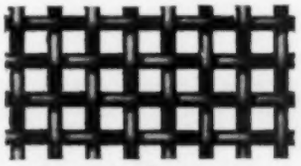
Roebling "Jersey" Screen can be furnished for practically every filtering, dewatering, cleaning, sizing and grading purpose. Made in a wide variety of metals.

ROEBLING
WIRE
SCREEN
FINE FILTER CLOTH TO COARSEST SCREEN
JERSEY


Dutch Weave Twilled Filter Cloth

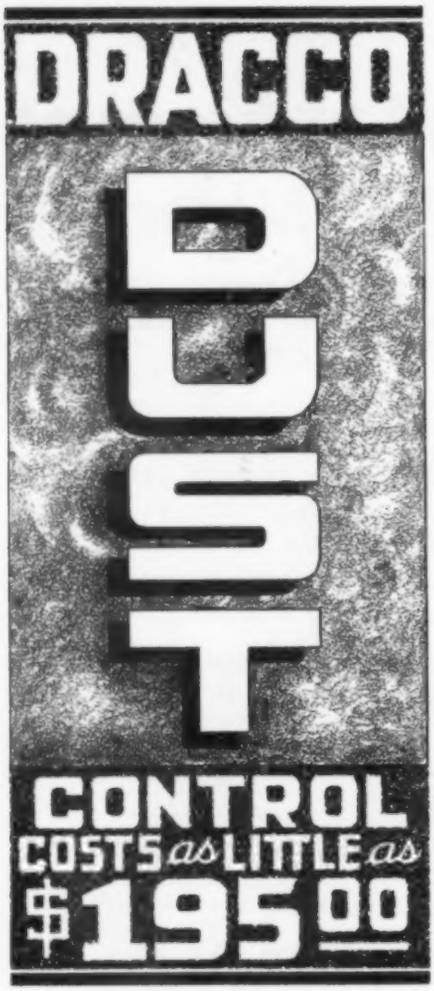
Jersey Stranded Flexible Filter Cloth


Oblong Mesh Wire Screen


Square Mesh Wire Screen

ROEBLING 1841 1931 100th ANNIVERSARY

JOHN A. ROEBLING'S SONS COMPANY
TRENTON, NEW JERSEY Branches in Principal Cities
Export Division: 19 Rector St., New York, N.Y., U.S.A. Cable Address: "Roebling's", New York



The cost of Dust Control depends upon the job to be done — many think it is expensive. In many plants one or several DRACCO Unit Filters will control Dust from individual operations for as little as $195.00 each. An installation costing only a few hundred dollars will eliminate a serious Dust hazard that causes a loss of many thousands of dollars each year. Consult DRACCO Engineers regarding ANY Dust Condition—large or small.

• For Further Information Write •

DRACCO CORPORATION

Successors to The Dust Recovering & Conveying Co.

4071 E. 116th St.

Cleveland Ohio

New York Office, 130 W. 42nd St.

PNEUMATIC CONVEYORS • DUST COLLECTORS

NEWS OF PRODUCTS AND MATERIALS

PIGMENT

A colloidal iron oxide pigment to be known as Mapico 297 has been announced by Columbia Carbon Co., New York, N. Y. The behavior in rubber compounds resembles that of colloidal carbon. The chemical and physical properties are expressly designed to meet the needs of the rubber compounder for a pure, bright and permanent coloring and reinforcing agent. It is an impalpable powder of flame tint and is essentially pure ferric oxide, minor constituents being held to a minimal proportion. A typical analysis of this pigment is as follows:

	Percentage by Weight
Soluble in HCl	99.8
Fe_2O_3	99.7
Ignition loss	0.3
Manganese	0.016
Soluble sulphates	0.01
Calcium (as CaO)	0.005
Alkalinity (as Na_2CO_3)	0.0003
Acidity	0.
Copper	0
Soluble iron salts	0
pH	8 to 9

AGE RESISTOR

An important research contribution for conserving supplies of natural rubber is Duramin, a combination of chemical age resistors discovered in the Akron laboratories of B. F. Goodrich Co. It will be used in the 1941 Silvertown tire line of the company. It is said to lengthen the service life of rubber products by retarding the effects of oxidation, the prime cause of premature aging. The vitamin-like material is used in the important portion of the tire between carcass and tread. It produces a cooler running stock by both reducing the amount of heat generated and better resisting it. So potent is Duramin that it is effective in minute amounts. In tires the quantities used range from ¼ of 1 percent to 2 percent of the amount of rubber in the compound.

FILLER OR PIGMENT EXTENDER

A newly developed filler or pigment extender that is designed to give better sheet brightness and opacity at lower cost, increased ink absorption or greater bulk, has just been announced by Johns-Manville. This material, Celite 340, is also recommended by the manufacturer as an economical means of controlling pitch trouble. It is described as an amorphous, diatomaceous silica, chemically treated and air-separated to produce a white very fine grit-free product with a G.E. brightness of 95. Among the characteristics listed are: very minute particle size, high oil and water absorption, and great building capacity.

SAFETY GLASS

Safety glass having a strength of ten or more times that of ordinary automobile safety glass has been developed by the Pittsburgh Plate Glass Co. Called Flexseal, the new glass combines the toughness, strength and elasticity of a special plastic with the hard surface, good vision and rigidity of a heat-treated glass. It is made much like ordinary safety glass which consists of two lights of glass with a vinyl plastic between them but in the case of Flexseal, the meat of the sandwich—the plastic—extends beyond the edges of the glass and serves as a rubber-like rim all around. This flexible rim can be bolted, screwed, cemented, pressed, or even nailed into window openings.

PLASTICS

Plastic products under the trade names Plastikmould and Plastiktrim, have been announced by the R. D. Werner Co., Inc., New York, N. Y., finisher of extruded metal moldings. These new plastic products are manufactured in a wide range of color in similar shapes and sizes as now supplied in aluminum. Also large tubes and other commercial items, both flexible and rigid.

DYESTUFFS

Three new dyestuffs have been added to the range of colors offered by the E. I. duPont de Nemours & Co., Inc.'s Dyestuff Division. All are applicable to the textile field. Pontachrome Fast Yellow R Conc., being of particular interest as a shading color for the production of olive drab shades, khaki, tan and brown shades of wool. Polyform Bordeaux RF is a formaldehyde after-treated direct color of special interest as a ground shade for colored discharge work both on viscose process rayon and cotton. It yields a deep bluish shade of red, somewhat duller than that of Pontamine Diazo Bordeaux RB. Pontamine Black BCN is a direct color, equal in strength but slightly brighter in shade and stains acetate rayon somewhat less than the older product, Seristan Black B. Fastness to light and perspiration is good. Its resistance to washing is moderate. It is recommended for use on cotton materials containing acetate effect threads which need not be pure white.

PIGMENT

A pigment produced by Pittsburgh Plate Glass Co. is called Silene. It is said to be a calcium silicate. When finally dried for market, Silene contains 5 percent free moisture and 15 percent combined moisture. It is a white pigment and the immediate use for which its production is being

B&W *Seamless* TUBES

IN THIS WIDE RANGE IS THE ALLOY YOU NEED

Croloy	Type No.
12	410
12-3-W	418
18	430
22	442
27	446
16-13-3	316
18-8 S	304
18-8-Cb	347
18-8-Ti	321
18-13-3	317
20-10	308
25-20	310

B&W STAINLESS CROLOY ANALYSES ARE COMPLETE

There are B&W Stainless Croloys for practically every type of service — for high temperatures, oxidation and corrosion resistance — all manufactured in the specialty tube mill that produced the first commercial quantities of seamless stainless steel tubing in this country.

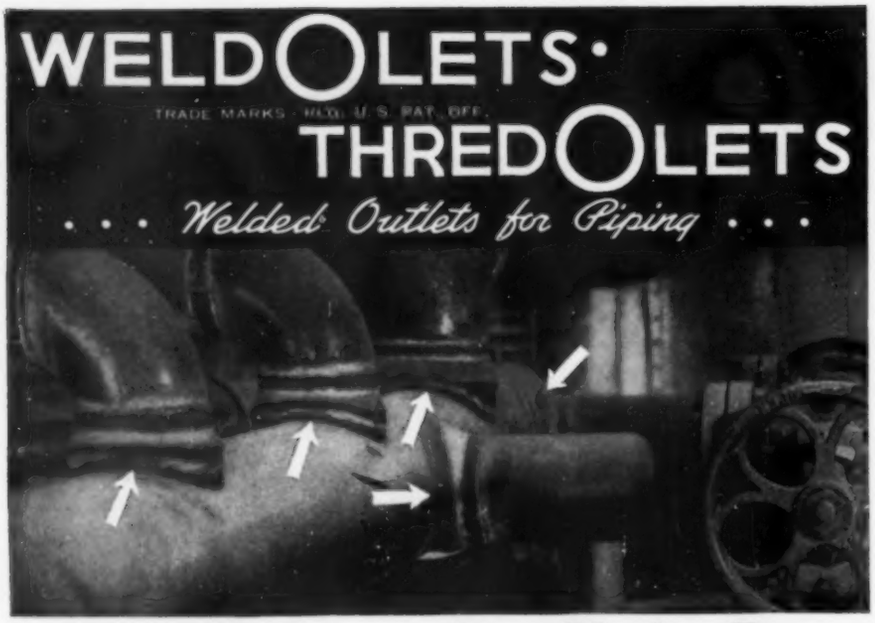
Technical Bulletin 1-A, containing valuable information on all the B&W Stainless Croloys, is available upon request.

TA-1156

BABCOCK & WILCOX TUBES

HOT FINISHED COLD DRAWN ALLOY STEELS CARBON STEELS

THE BABCOCK & WILCOX TUBE COMPANY, BEAVER FALLS, PA.



Header Construction Made Easy with WeldOlets and ThredOlets

WELDED header construction is simplified by using Bonney WeldOlets and ThredOlets in making branch "take-offs".

WeldOlet

Not only do they eliminate all cutting and fitting of the main pipe, but they provide leak-proof joints of full pipe strength. They may be installed on the main either before or after erection and without the use of templets.

ThredOlet

They are designed with a heavy, external rib to compensate for the loss of strength in the main pipe that occurs when the hole is cut.

Their funnel-shaped aperture keeps turbulence and friction to a minimum and their wide footings offer ample resistance to bending stresses.

Socket-End WeldOlet

WeldOlets and ThredOlets are recommended for all commonly used pressures and temperatures on all types of piping installations.

Be sure you have full information about all the advantages of WeldOlets and ThredOlets before doing your next piping job.

AS EASY AS LIGHTING YOUR PIPE

(1)—Select the position of the outlet, rub the fitting over the pipe several times to remove scale, mark center lines and tack the WeldOlet or ThredOlet into position. (2)—The fitting is then welded into place by the electric-arc or oxy-acetylene method. A junction of full pipe strength and a leak-proof outlet is the result. (3)—Where the outlet is 2" or larger, the button should be removed after the welding operation. On small sizes the fitting is used as a templet and the hole is cut in the main pipe first, either with a hole saw, the torch or by drilling. Inspection of the inside of the joint is possible by using WeldOlets and ThredOlets, allowing removal of all scale, welding metal, etc. (4)—The branch line is then welded into position. In the event a ThredOlet is used the branch pipe is threaded and screwed into place.

BONNEY FORGE & TOOL WORKS
Forged Fittings Division - Allentown, Pa.
Forged by the Makers of
The Finest that Money Can Buy
BONNEY TOOLS

undertaken is as a filler for rubber, presumably to replace zinc oxide.

CLEANING COMPOUND

Cleaning compound in briquet form is Super-Mafos developed by the Mathieson Alkali Works for use in dish-washing machines. Its formula was selected from several hundred after two years of research. It is made of a combination of six detergents which are effective on the several types of food residue, together with tetra sodium-pyrophosphate which is a water softener. The constitutents are subjected to a low-temperature fusion process and after thorough agitation in the liquid state are molded into hard briquets.

CHEMICALS

Products that are now being produced on a laboratory scale, and can be obtained from the Glyco Products Co. are:

Propylene Glycol Distearate S 297
Stearic Ethanolamide S 267
Carbitol Oleate S 290
Diethylene Glycol Monostearate S 246
Nonaethylene Glycol MonoOleate S 293
Nonaethylene Glycol Dioleate S 294

UNDERCOAT

An automotive refinishing material Dulux make-ready undercoat, designed to improve adhesion when synthetic resin enamels are applied over old finishes, is announced by the Finishes Division of the E. I. duPont de Nemours & Co., Wilmington, Del. It is said to reduce the time required for refinishing. Du Pont specialists prescribe the following routine for use. All wax, polish and grease must be removed from the surface with Prep-Sol before application. Where the finish is broken it should be sanded bright and feathered at the edges. Broken or badly weathered areas should be spot-sprayed with high speed Pyroxylin Primer-Surfacer and allowed to dry for 30 minutes. Make-ready requires reducing with an equal volume of Duco Pyroxylin lacquer or Pyralux thinner. The smoothest surface may be obtained by spraying at 40 to 50 lb. pressure. The undercoat should be allowed to dry for one-half hour and Dulux enamel sprayed on immediately.

WATERPROOF FABRIC

Waterproof fabric that combines the unique advantages of a fabric made of nylon with the Endurette waterproof finish is Endurette Nylon made by Endurette Corp. of America, Cliffwood, N. J. It is inherently strong and serviceable and is unusually attractive in appearance. This waterproof fabric is absolutely waterproof in contrast with mere repellancy. The new fabric's outstanding flexibility of hand, which it retains indefinitely, is a most important feature. It is de-

signed to be used in a great many important fields. Outstanding among these are rainwear, shower curtains, umbrellas, chemical and household aprons, army suits and uniforms, hospital uses, lamp shades, dress shields, etc. In the industrial field, Endurette Nylon will be used for insulating fabrics and other uses. It is said to be proof against grease, oil, stains, mildew and moths. It is resistant to acid and heatproof to 300 deg. F. It will not stick, harden or become lumpy. It may be washed, dry cleaned, laundered and even ironed through a cloth. It will not shrink or stretch.

PROTECTIVE PAINT

Paint developed for the protection of metal, concrete and wood (against corrosion and chemical reactions) is known as Tygon and is produced by the United States Stoneware Co., New York, N. Y. It is recommended for jobs involving severe corrosive conditions that other paints or coatings cannot handle. It may be brushed, sprayed or baked. It comes in a wide range of colors as well as in white, black and "clear." One gallon will cover about 200 sq.ft. It is said to withstand action of all acids, salts and alkalis including nitric, hydrofluoric, hydrochloric, sulphuric and chromic acids (concentrated formic and acetic acids alone excepted). Chromium, cadmium, nickel, copper, tin, silver, gold and other plating solutions can be handled with safety.

SKIN PROTECTIVE

Intensified industrial activity for defense production has caused the Milburn Co., Detroit, manufacturers of PLY protective products, to introduce a new waterproof PLY No. 6 for the prevention of skin disorders caused by contact with acids and caustic compounds in both dry and aqueous form. It is an ointment which is applied over the exposed parts of the skin leaving a thin white film, but in no way interfering with the efficiency of the men or the process in which it is involved. It serves as effective protection against strong sulphuric, muriatic, nitric, hydrocyanic and many other acids. Laboratory tests show perfect resistance to as high as a 20 percent concentration of nitric acid. Strong caustic, metal cleaners, soaps, biologicals, dyes, dye intermediates, insecticides, rubber compounds and impurities, explosives and metal salts are also hazards which are nullified through the use of PLY No. 6. This new ointment requires only a thin application over the areas which are exposed. It has been estimated that a single pound of the substance will last under average working conditions from four to five months. It is easily removed with ordinary soap and warm water at the end of each working period. It is perfectly harmless to the skin.

Improve Your Pump Performance

DURAMETALLIC

OIL PRESSURE UNIT

for

Circulating Lubricating Oil at a UNIFORM PRESSURE

SELF CONTAINED UNIT
READY TO CONNECT
USES LITTLE SPACE

MEETING the need for supplying lubricating oil at desired uniform pressure to lantern glands of stuffing boxes. It has a dependable new type pressure regulator adjustable from zero to 1000 lbs. Comes complete with cooling coil and filter. Electric motor or turbine driven.

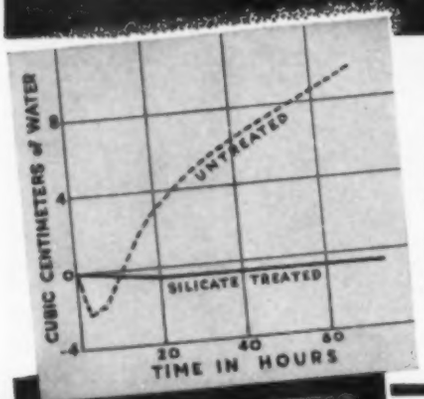
WRITE TODAY FOR ILLUSTRATED BULLETIN COVERING STANDARD SIZES TO HANDLE 1 to 10 STUFFING BOXES

The PERFECT SEAL

DURAMETALLIC CORPORATION

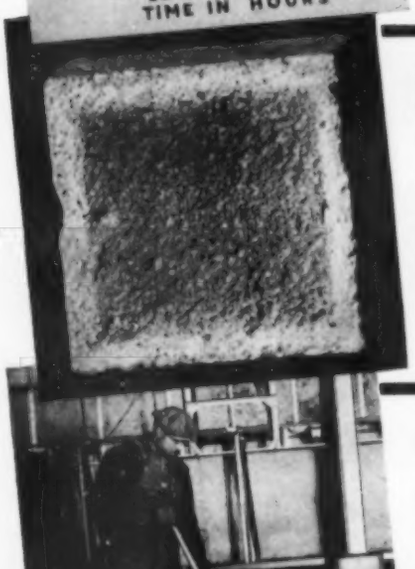
KALAMAZOO MICHIGAN

LONGER LIFE *for Concrete*
Treat with Silmac Silicate



WATERPROOFS

Concrete tanks, walls, building blocks, etc., allow water to penetrate to some extent, resulting in dampness and often actual seepage. The efficiency of the Silmac treatment is indicated in the accompanying graph.



DUSTPROOFS

By chemical reaction of the Silmac and the concrete a hard insoluble substance is formed at the surface. Hard, wear-resisting, dustless concrete outlasts untreated concrete. At left, degree of Silmac penetration shown by white outer edges.

ACIDPROOFS

Silmac-treated concrete admirably resists acid attack. Successful applications have been made against hydrochloric, sulphuric, as well as organic acids. Silmac also protects concrete against the attack of brackish water.

Silicates PQ *of Soda*

3 REASONS!

—you should investigate Silmac Silicate for concrete treatment—It's economical—It's easy to apply—It's effective. We'll gladly help you estimate quantity needed for your concrete area. Free bulletin #341 gives complete information.

PHILADELPHIA QUARTZ CO.

Established 1831 General Offices and Laboratory: 125 S. Third Street, Philadelphia, Pa.
Chicago Sales Office: Engineering Bldg. Sold in Canada by National Silicates Ltd., Toronto, Ont.

PRESERVATIVE

A wood and fabric preservative that has proved effective in stopping insect and fungi attacks is Cuprinol. It was introduced to England about 12 years ago and used to check fungus growth and insect attack on many famous old buildings such as Windsor Castle, Westminster Abbey and Durham Cathedral. After exhaustive field tests Cuprinol was adopted by the British Government for the Army, Navy and Royal Air Force. It is specified for sandbags, tents, camouflage cloth, awnings, tarpaulins, parachute harnesses and airplane safety belts. This product is an oily liquid about the consistency of water that may be applied by brush, spray or dipping. It has a base of copper sulphate which penetrates the wood or fabric, protecting it from mildew, dry rot, etc. There are different types of Cuprinol for both wood and fabric, depending upon the requirements and conditions of service. It is made by Cuprinol, Inc., Cambridge, Mass.

THREAD

The housewife may now obtain nylon thread for both home sewing and machine stitching. Tests show that this thread has great strength and elasticity permitting garment seams to stretch under unusual strain without danger of breaking the stitches. Bias seams, too, stand the strain of longitudinal stretching. Nylon thread is also resistant to rot from perspiration, does not shrink when a garment is dry-cleaned or washed, is not adversely affected by normal ironing conditions, but as with all fine fabrics, use of a very hot iron should be avoided. This thread is manufactured by Belding-Heminway-Corticelli Co. of New York, N. Y.

SOLVENT—PLASTICIZER

Liquid resins that are solvents, plasticizers and penetrants as well are Hercolyn and Abalyn, produced by Hercules Powder Co., Wilmington, Del. The former is methyl abietate that has been hydrogenated for stability while the latter is straight methyl abietate, reactive and oxidizable. Both of these interesting rosin esters are liquid, pale straw in color, boiling at about 370 deg. C. with almost no decomposition for they are completely heat stable up to 350 deg. C. They are excellent plasticizers for they have a vapor pressure of only 5 mm. mercury at 200 deg. C., and almost none at all below that point. Resinous in nature they are compatible with almost all gums, resins, waxes and film formers, and are soluble in a wide variety of common solvents. Thus, they can be used as modifiers, co-solvents, or coupling agents and their very ready emulsifiability increases their value. These two liquid resins have interesting special properties too and are already in wide use in lacquers, varnishes, paints, inks, waxes, paper, perfume, plastics and many other industries.

"I'M WORRIED ABOUT 75 M.M. SHELLS— NOT MUD IN A RIVER!"

True enough and only natural. Mr. Designing Engineer is worried a lot about shells—very little about the mud, hardness and coloring matter in that river back of the plant.

He's worried about production—how many shells, how many tanks, roll off the line each day. And rightly so. For production is his problem.

But this problem of getting the suspended and dissolved material out of his river water before it gets into his plant supply or his condensers is a big one too. So is the problem of getting the impurities out of his plant wastes before they pollute the same river.

We have been treating water—2½ billion gallons a day of it—for 20 years. We have been treating sewage too, on a large scale—close to 5 billion gallons a day.

Here, then, are two places where we can help you, Mr. Designing Engineer—two special headaches that can be eliminated from the many that must be plaguing you these hectic "speed-up" days.

Clean water and properly treated plant wastes are essential in industrial operations and power plants, today. The rapidly increasing tempo of production and expansion has enhanced their importance to both heavy fabricating plants and process industries.

DORRCO

THE DORR COMPANY INC.

ENGINEERS • 570 Lexington Ave., New York

ATLANTA • TORONTO • CHICAGO • DENVER • LOS ANGELES

DORR TECHNICAL SERVICES AND EQUIPMENT ARE ALSO AVAILABLE FROM THE FOLLOWING COMPANIES:

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ITALY: S.A.I. Dorr-Oliver, Milan • JAPAN: Sanki Eng. Co., Ltd., Tokyo • SCANDINAVIA: A.B. Hedemora, Hedemora, Sweden • AUSTRALIA: Crossle & Duff Pty. Ltd., Melbourne
ARGENTINA: Luis Fiore, Buenos Aires • SOUTH AFRICA: Edward L. Bateman Pty. Ltd., Johannesburg • BRAZIL: Oscar Taves & Co., Rio de Janeiro

Chem & Met MEETINGS & CONVENTIONS

A.I.Ch.E. and A.P.I. Feature Month

FEATURING conventions held during the past month were those of the American Institute of Chemical Engineers in Chicago and the American Petroleum Institute in Tulsa, Okla., both of great interest to chemical engineers. In line with the policy of *Chem. & Met.* to keep its readers informed of major chemical and engineering developments as disclosed at meetings and conventions of technical organizations, selected papers presented before the following societies have been abstracted and are given in this issue:

American Ceramic Society
American Chemical Society
American Institute of Chemical Engineers
American Petroleum Institute
Electrochemical Society
Midwest Power Conference

HEAT TRANSFER

HEAT TRANSFER to a fluid in laminar flow through an annular space was reported upon before the American Institute of Chemical Engineers in Chicago by M. Jakob, Illinois Institute of Technology, and K. A. Rees, Armour Research Foundation, and the theory of heat transfer between either one or both walls of an annular space in a substance in laminar flow through it was developed for the case of uniform heating or cooling. Results were given in dimensionless form with the independent variables r_i/r_s and $P_i/(P_i + P_s)$ where r_i and r_s are the radii of the annulas and $100P_i$ and $100P_s$ are the percentages of heating from inside and outside, respectively. In the case of one-sided heating ($P_i = 0$ or $P_s = 0$) the group hr/k is used as a dependent variable where r is the radius and h is the coefficient of heat transfer for the heated surface, and k is the heat conductivity of the gas. In the case of heating or cooling from the sides, $dt/\Delta t$ is chosen as dependent variables where dt is the temperature difference between the two surfaces and Δt the temperature change in axial direction. The relations between these variables were represented in equations, tables and graphs.

The theory was checked by experiments with ethylene, hydrogen and air in laminar flow through a long and narrow annulus with $r_i/r_s = 0.5$. The annulus was insulated inside and heat energy was supplied from electrical coils surrounding it. A minor part of the heat energy was given up to the gas by a detour, namely from inside, after having crossed the annulus in the form of radiation.

Under the experimental conditions, the theory led to $hr/k = 3.52$, regardless of the kind of gas and of Reynolds number. The experiments, however, gave average values which were larger by 19 percent, 5 percent, and 10 percent for ethylene, hydrogen and air, respectively, including a slight increase in the range of $Re = 50$–$1{,}000$. This may indicate an early transition to turbulence, while the differences of hr/k for the three gases can originate from a temperature correction of restricted accuracy. That all observed values are greater than the theoretical was ascribed to eccentricity of the annulus. The average discrepancies between experiment and theory of 5–20 percent were not considered as very serious, especially since k for hydrogen is seven times greater than for air, and 10 times greater than for ethylene.

RESIN-TREATED COMPRESSED WOOD

DISTINCT new possibilities for manufacture of airplanes, flooring, paneling and furniture are offered by compressed wood treated with a commercially available phenol-formaldehyde resin-forming mix, according to A. J. Stamm and R. M. Seborg of the Forest Products Laboratory, Madison, Wis., before the American Institute of Chemical Engineers in Chicago, last May. The authors succeeded in producing a compressed wood with a very hard, smooth, weather-resistant surface, which is also highly resistant to alcohol and water.

In the method outlined, resin-treated compressed wood is made from the dry-treated plies under pressure of 250–1,200 lb. per sq.in. at temperatures of 300–320 deg. F., using pressure periods of 15–30 min. per inch of original thickness of wood. Among the woods experimented with were spruce, cottonwood, aspen and several species of poplar.

Veneer can be resin-treated in either of two ways: (1) by a diffusion of the resin-forming mix into green veneer by merely soaking in a water solution of the mix; (2) by treating dry by the cylinder method in which the veneer is placed on edge in a galvanized iron tank inside the treating cylinder, the tank filled with treating solution, and the veneer weighted down. The cylinder is closed and an air pressure of 30–60 lb. per sq.in. is applied for 15–60 minutes. The veneer is then slowly dried so that the resin-forming constituents can diffuse from the fiber cavities of the wood into the cell walls as water is removed from the fiber cavities.

Resin-treated compressed woods show several possible uses in airplane construction, the most promising application being for fuselage and wing covering and for spar plates. The treated veneer could also be used to advantage in making propeller blanks varying in specific gravity from one end to the other, or even in molding the propellers to their final shape, according to the authors.

LIQUID-LIQUID EXTRACTION COLUMN

CHARACTERISTICS and performance of a liquid-liquid extraction column were given by S. B. Row, Southwestern Louisiana Institute, J. H. Koffolt and J. R. Withrow, Ohio State University, before the semi-annual meeting of the American Institute of Chemical Engineers in Chicago last May. The paper supplied new experimental data on a large 8.75 in.-diameter glass extraction column, using the chemical system of Appel and Elgin, namely toluene-benzoic acid-water. Various series of old and new type column arrangements with old and new type of packing ma-

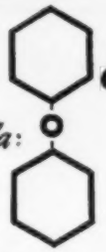
CALENDAR

JUNE 23-27,	American Society for Testing Materials, annual meeting and exhibit, Palmer House, Chicago, Ill.
SEPT. 8-12,	American Chemical Society, semi-annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.
SEPT. 16-19,	Technical Association of the Pulp and Paper Industry, Ann Arbor, Mich.
SEPT. 17-19,	National Petroleum Association, annual meeting, Hotel Traymore, Atlantic City, N. J.
OCT. 1-4,	Electrochemical Society, semi-annual meeting, Hotel Knickerbocker, Chicago, Ill.

General Chemical Announces

O—PHENOXY-BENZOIC ACID

For Commercial Use



Structural Formula:

Physical Properties:

APPEARANCE—white crystalline solid.
MOLECULAR WEIGHT—214.
MELTING POINT—112-113° C.
BOILING POINT—355° C., with some decomposition.

Solubilities:

Insoluble in cold water, slightly soluble in hot.

Easily soluble in alcohol, ether and most common organic solvents.

Chemical Properties:

1. The aromatic rings undergo typical aromatic substitution reactions such as halogenation and nitration.

2. The carboxyl group exhibits its usual properties, forming salts, esters, acid chloride, etc.

Possible Industrial Applications:

1. The acid may be used as an intermediate for miscellaneous organic syntheses.

2. Its esters may find application in the preparation of pharmaceuticals and the formulation of resins and plastics.

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For Mixing or Blending insecticides, powders, pigments, dyes, chemicals, etc.

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terials were investigated under a wide range of flow conditions. These included "spray column," "bubble cap" column, perforated plates, columns packed with Berl saddles and Raschig rings, and three arrangements of pitted copper-cloth packing.

Some of the conclusions drawn by the authors were as follows:

(1) Colburn's method of correlating liquid-liquid extraction data was found to be simple, clear, concise, and permitted a rapid evaluation of results.
(2) High rates of flow of the continuous phase affected the overall height of transfer unit results differently than low rates of flow (this effect was minimized by increased rate of the discontinuous phase and by the use of packing materials).
(3) Raschig rings and Berl saddles were found to be the most efficient of the arrangements used, with Berl saddles probably the better.
(4) Size of distributor hose for the discontinuous phase influenced the capacity and the H.T.U. values, the smaller the size, the greater the capacity and efficiency of the tower.
(5) Perforated plate and "bubble cap" columns were found to be practically equally efficient.

TANK CARS FOR CARBON DIOXIDE

THE BULK, low-pressure method (U. S. P. 2,180,231) of handling carbon dioxide makes it possible to transport, store, and transfer cold liquid with great economy, according to C. A. Getz and Eric Geertz of the Cardox Corp., Chicago, Ill. before the American Chemical Society in St. Louis. Thus "pay load" is much improved over high-pressure cylinder hauling. Several tons of liquid can be transferred in a few minutes. Less floor space is required to store a given amount of gas. This new method of handling liquefied CO_2 takes advantage of reduction in vapor pressure with lowering of temperature. For example, by refrigerating to 0 deg. F., a pressure of only 290.8 lb. per sq.in. is exerted. This makes it economical to build large vessels of ample strength to hold the liquefied gas. Pressure vessels for this purpose have been manufactured in capacities from 0.25 to 125 tons. Each vessel is thermally insulated to prevent excessive heat absorption and insulation and vessel are hermetically sealed inside a sheet metal housing.

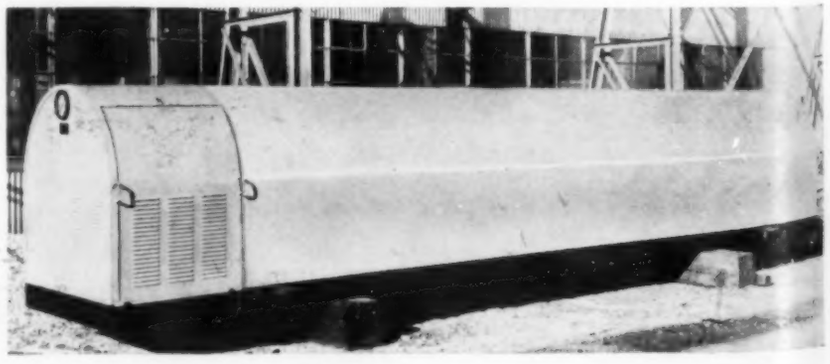
Storage tanks are equipped with a refrigerator coil and mechanical refrigerator. When the pressure reaches a set point, a pressure-controlled switch causes the refrigerator to operate until the temperature and pressure have been lowered. Transportation tanks need not be equipped with mechanical refrigeration as under most conditions, pressure rise during a haul is small. In case the pressure rises to near the upper limit of the normal working pressure of the vessel, it is maintained at that pressure by automatically releasing vapor. A valve (composition seating disc and diaphragm operated) has been developed to give very slow release and small "blow down."

Both storage and transportation tanks are equipped with special, metal seating, safety pop valves. Each vessel is equipped with a pressure gage and liquid level gage. Special electrical alarm contacts can be provided with both units to give automatic warning of abnormal changes in pressure or liquid level. Liquid CO_2 is transferred from tank to tank by means of high capacity centrifugal or rotor and stator pumps. A 1.5 in.-diameter hose is used for the liquid flow. The vapor spaces of the two vessels are connected with pressure equalizing hose during the transfer. Studies with 100 deg. F. ambient temperature and 0 deg. F. CO_2 show that the overall heat input per square foot of vessel surface is about 8 B.t.u. per hour if insulating material is 8 in. thick. Insulating materials studied include Kapok, vegetable cork, rock cork, vacuum and rock felt. The size refrigerators required for various capacity tanks are as follows:

Tons	Hp.
0.25	0.167
0.5	0.25
1	0.5
2-3	0.75
4	1.0
5	1.5
6-10	2.0

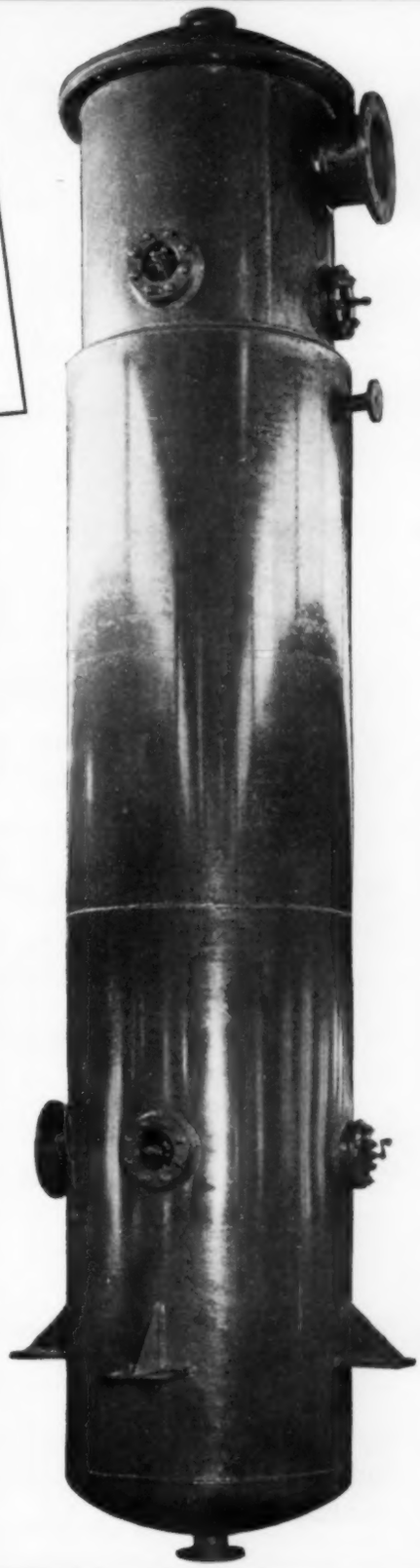
With the refrigerator and tank combinations shown above, it was found that refrigerator running time is less than 65 percent at 100 deg. F. room temperature and 0 deg. F. CO_2 temperature. The value of 40 B.t.u. per sq.ft. of copper-coil surface per deg. F. differential coil temperature is satisfactory in determining coil size. Rate of pressure rise with no refrigeration varies inversely with the capacity of the storage vessel. Pressure rise in a 4-ton storage tank when at 100 deg. F. ambient is about 2 lb. per sq.in.

A Cardox 4-ton capacity, low-pressure liquid carbon dioxide storage unit requiring a 1 hp. motor for refrigeration. Units have been manufactured in capacities up to 125 tons



PATTERSON EQUIPMENT FOR A PROCESS INDUSTRY

Patterson Vertical Distributor, 48" x 17'6". All welded steel construction. Jacketed for 100# steam with a full vacuum in the shell. Top head is bolted and sight glasses are provided for complete observation. All welding by Code qualified welders.



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4. What is the approximate weight per cubic foot or gallon of the ingredients?
5. Will it be necessary to heat or cool the mass during the mixing process?
6. In the case of steam heating, what pressure will be used in jacket?
7. Is the mixing to be conducted under pressure or vacuum?
8. What type of discharge outlet is preferred?
9. Is the machine to be belt driven or provided with individual motor drive? If motor drive, give current characteristics.

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SOLVENT EXTRACTION OF SOYBEAN OIL

USE OF selective solvents to obtain from soybean oil a highly unsaturated fraction was investigated on a laboratory scale and reported before the American Institute of Chemical Engineers in Chicago by R. E. Ruthruff and D. F. Wilcock of the Sherwin-Williams Co. The method found to offer greatest possibilities consists of extracting raw soybean oil with furfural to obtain a highly unsaturated constituent and then further extracting with a hydrocarbon solvent to eliminate materials which retard drying by acting as antioxidants.

A flowsheet based upon experimental work shows raw soybean oil entering the bottom of the furfural extraction tower and meeting a descending stream of solvent from the storage tank. Raffinate oil plus some furfural collects at the top and furfural plus extracted oil collects at the bottom. Extract from the furfural tower is passed to the top of a single-stage naphtha-extraction tower. Naphtha is added to the bottom of the tower to extract as much oil as possible, with a minimum of antioxidant, from the furfural-extract phase. This naphtha, containing the greater part of the extracted oil, is removed from the top of the tower and is fed to the first naphtha flash tower from which naphtha is taken overhead and returned to the reservoir. Antioxidant-free extract oil is removed from the bottom of the first naphtha flash tower.

Naphtha-extracted furfural (containing antioxidants and some high-iodine number oils) is removed from the bottom of the single-stage naphtha extraction tower and added to the raffinate from the furfural tower. The resulting mixture is extracted with naphtha in a multi-stage tower. Naphtha containing the oil and antioxidant is removed from the top of this tower and distilled in the second naphtha flash tower in which antioxidant-bearing raffinate is removed from the bottom, while the naphtha is flashed overhead. Naphtha-treated furfural from the multi-stage naphtha extraction is sent to the furfural storage for recycling.

GASES IN BOILER FEED WATER

LITERATURE states that gas diffusion from a quiescent surface is inversely proportional to the 2/3 power of the liquid viscosity. However, in the case of liquid falling over trays, viscosity of the liquid not only affects the theoretical diffusion coefficient, but also the turbulence within the particles of liquid and the actual amount of interfacial surface exposed. Tests on the removal of dissolved gases from water, reported upon by A. E. Kittredge of the Cochrane Corp., Philadelphia, before the Midwest Power Conference in Chicago last April, showed that with equipment used, tray efficiencies were inversely proportional to the 4/3 power of the liquid viscosity.

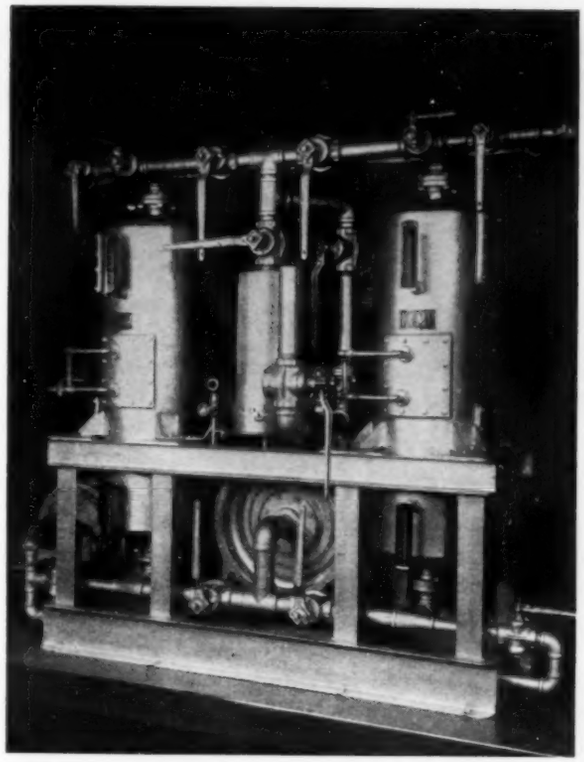
Tray deaerators for boiler feed water

have broad applications and are designed to deal efficiently with the remaining 5–10 percent of oxygen initially contained in water saturated with atmospheric air. Only the downflow type is under basic patent protection at the present time. It was stated that under extreme overload, the counterflow type will suffer damming and flooding of incoming water and the crossflow type will suffer poor water distribution, whereas with the downflow type the higher the load, the better the water distribution.

Tray deaerators are of two types; the more simple design consists of a perforated water distributing pipe, a bank of heating and distributing trays and a deeper bank of air separating trays. Steam enters the top through a perforated distributing baffle and flows downward through the entire assembly to the vent condenser. This design claims perfect distribution of steam and water and inherent ability to carry heavy overload without reaching a critical operating point. Under normal operating conditions, assuming atmospheric pressure, the concentration of oxygen in vent gases would support only 0.00003 cc. per liter in the effluent boiler feed water. Under emergency condition requiring 100 percent of feed from the make-up tanks, concentration of oxygen in the vent vapor might support as much as 0.001 cc. per liter in the effluent boiler feed water. A cross-section of a tray deaerator of this design is shown in the accompanying figure.

Tray deaerator for boiler feed water

For conditions requiring zero oxygen guarantee, preliminary deaeration is accomplished in a direct contact preheating vent condenser. Water to be deaerated passes through the usual surface vent condenser and is sprayed in the preheating and deaeration chamber which serves as a vent condenser to the main tray stack. Water leaving



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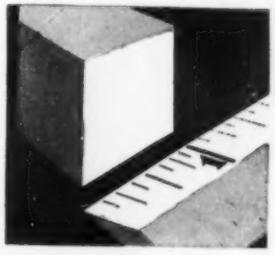

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this chamber contains only that amount of oxygen retained by the surface tension. The vent rate from the main deaerating tray section consists of the entire steam supply to the equipment. Concentration of oxygen in the vent gases of this type of equipment, measured in terms of its ability to support oxygen in solution in the feed water, is normally of the order of 0.00002 cc. per liter.

PLASTICS FROM AGRICULTURAL WASTES

ACCORDING to O. R. Sweeney, W. D. Harris, and L. K. Arnold, Iowa State College of Agriculture and Mechanic Arts, Ames, Ia., before the semi-annual meeting of the American Institute of Chemical Engineers in Chicago, May 21, a thermoplastic molding powder can now be produced at an estimated raw material cost of 4.1 cents per lb. and a thermosetting powder at an estimated cost of 6.3 cents per lb., based on the cost of corncobs at 0.5 cent per lb.

Raw materials for production of the thermoplastic molding powder are corncobs, oat hulls, or other pentosan-containing cellulosic waste product, cresol or phenol, sulphuric acid and asbestos filler. When about 70 percent cresol was used, some of the cobs acted as filler and the product was molded without additional filler. When 130 percent cresol was used, the cobs reacted completely and filler was added to make a moldable plastic which was thermoplastic. In the production of the thermosetting product, hexamethylenetetramine, calcium hydroxide, aluminum stearate, asbestos and furfural are used. Both thermoplastic and thermosetting materials are black, shiny products which mold readily into forms possessing good strength and high resistance to water.

According to the authors, additional experimental work is now in progress which may result in reducing costs, increasing strength, and decreasing curing time.

FUEL ECONOMY IN REFINERIES

SINCE FUEL costs represent 20–30 percent of total direct operating costs in an oil refinery, this is a very attractive field in which to reduce operating expenses, reported D. C. Lawrence of the Texas Company, New York, before the American Petroleum Institute in Tulsa, Okla. last May. In general, fuel cost for utility purposes can be kept to a minimum by efficient generation and usage. Inasmuch as generating facilities and necessary operating personnel are centralized and operation is routine, efficient generation of utilities should not present any particular problem. Usage of utilities is, however, quite a different problem. To maintain a high efficiency in usage, modification and changes are required. Fuel consumed by processes may be reduced by efficient heater design, by heat exchange from hot streams to incoming charge, to reboilers, to steam generators and to boiler feed water.

In discussing savings of fuels used

directly by processes, the author used as illustration two-stage distillation of a solvent-recovery system. An early design for solvent recovery utilized single distillation under 25 in. mercury vacuum and high circulating rates through the heater. A later design made use of two-stage distillation. Here the incoming mix charge was exchanged first against the vapors from the atmospheric section of the tower, and then against the vapors from the 40-lb. section of the tower before going into the atmospheric section of the tower. Approximately 40–45 percent of the work is done in the atmospheric section of the tower. The 40-lb. section removes about 50 percent of the solvent, and 5 percent is removed in the stripper. The average fuel consumption for solvent recovery was reduced 47.3 percent due to the use of two-stage distillation.

In addition, the author showed how savings in fuels could be accomplished by using heat exchange from hot streams, by employing liquid-gas storage for balancing gas production and consumption and by heat recovery from recirculating reflux.

SURFACE HARDENING BY INDUCTION

ONE OF THE outstanding developments in heat treating has been the application of induction heating to localized surface hardening, reported Dr. H. B. Osborn, Jr. of the Tocco Division, Ohio Crankshaft Co., Cleveland, Ohio, before the Electrochemical Society in Cleveland last April.

Induction hardening results in a locally hardened steel with the desired magnitude and depth of hardness, essential metallurgical structure of core, demarcation zone and hardened case, with lack of distortion and no scale formation. It permits mechanization of operations to fulfill production lines requirements. Time cycles of only a few seconds are maintained by automatic regulation of power and split-second heating and quenching intervals. Induction hardening equipment permits the user to surface harden only the requisite portion of the object and thus to maintain the original ductility and strength; to harden articles of intricate design which otherwise cannot be feasibly treated; to eliminate expensive pre-treatment such as copper-plating and carburizing and subsequent straightening and cleaning operations; to reduce material costs by allowing a wide selection of steels; and to harden a fully machined item without any finishing operation.

All surface hardening equipment consists of an inductor, quenching auxiliaries, suitable transformers and capacitors, automatic timing controls, and a high frequency generator. The inductor may be a single or several turns of copper tubing to fit the piece to be hardened. The quenching medium is supplied through the inductor by means of orifices. The timing device which controls the heating cycle operates an electric quench valve and controls the quenching cycle to the

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9th REPORT

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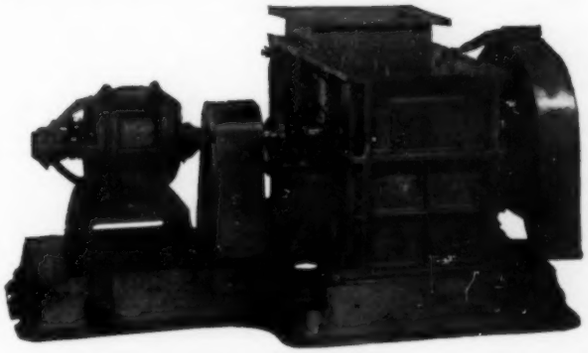

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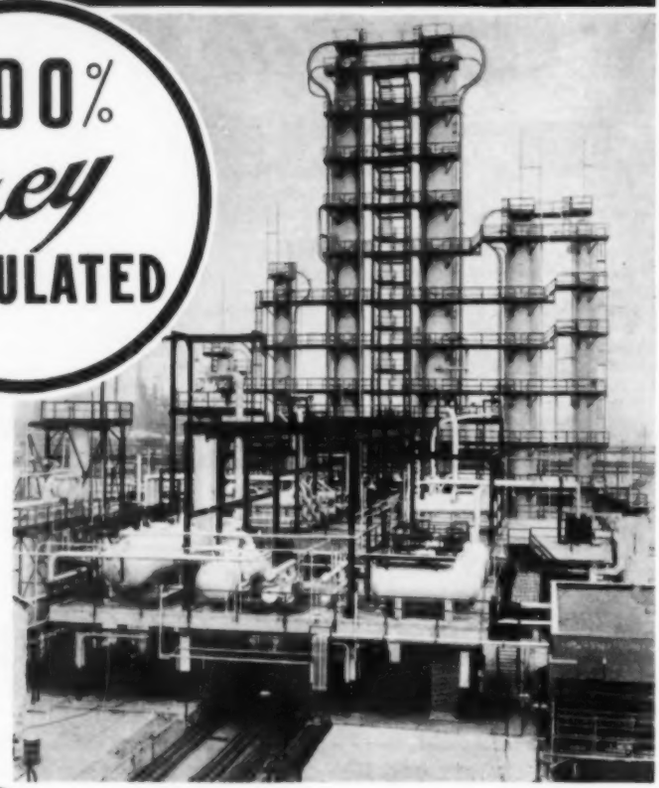

GULF DOUBLES ITS FACILITIES FOR MANUFACTURE OF AVIATION GASOLINE AT PORT ARTHUR REFINERY

Keeping pace with the rapid industrial expansion of the Southwest, the Gulf Oil Corporation has added a new unit to its Port Arthur, Texas, refinery. The increased facilities represent a major investment and were made to meet the normal domestic demand for aviation gasoline.

CAREY Heat Insulations were used throughout in this improvement.

The economics of present-day refining processes call for higher and still higher efficiency—and this means more and better insulations. The extensive use of CAREY Insulations by leaders of the industry is abundant evidence of the ability of these products to meet every requirement and to effect maximum savings.

Constant research and improvement; more than a half century of manufacturing experience; the practical knowledge gained from contact with every insulation problem—these are CAREY assets that rule out experimentation and assure dependable results. You're always SAFE with CAREY. A nationwide organization is at your service. Write Department 15 for Insulation Catalog.

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same degree of accuracy. Converters of the generator type are in use for 2,000, 3,000 and 10,000 cycles at capacities up to 1,000 kw. Smaller 7.5–30 kw. units of the spark-gap oscillator type are used at frequencies upwards of 100,000 cycles. High-frequency current is usually generated at high voltage ranging from 200–1,000 v., and is then transformed and fed into the inductor. A recent development is a small, compact, single-unit 3,600-r.p.m. generator producing 10,000-cycle current at 220 and 440 v. up to 100 kw. output. Other features of equipment were described.

Typical of applications on a production basis is the hardening of bearing surfaces on a large diesel crankshaft. Such parts are handled in a horizontal position in a tunnel line unit in which each bearing is hardened by means of an inductor block. Crankshafts which can be handled without mechanical equipment are treated in a vertical unit in which three or four bearing surfaces are hardened in one automatically controlled operation. Several such units, each set for a different series of bearings, can be operated by one man to yield a continuous output.

In the automotive field, the economical hardening of camshafts eliminates costly pretreatment, hardening, straightening and cleaning operations, and produces a shaft free of distortion and scale and hardened only where necessary. Each camshaft unit automatically hardens two shafts with one loading operation. The cams are hardened to 60 Rockwell "C" and the integral helical gear to 52 Rockwell "C" with cast iron, alloy or plain carbon steels. Putting bearing races on automobile axle shafts by placing a hardened material on the portion of the shaft requiring a bearing race is expensive. Application of induction hardening to this problem results in surface hardening the shaft at the desired areas and making the shaft act as its own bearing race. Equipment for hardening two such surfaces simultaneously is shown in the accompanying figure.

Surface hardening bearing races of two axle shafts simultaneously

In addition to selective surface hardening of steels, there are other applications of induction heating. Hardening a piece of steel and brazing to copper and other metals can be done simultaneously. Heating for forging and upsetting has been found to be a particularly satisfactory use for induction heating, as its speed has made it adaptable to high production requirements of forming equipment, and scale problems are reduced to a minimum. The corresponding increase in die life is of extreme importance. Tip annealing of brass cartridge shells at the rate of 100,000 per hr. is provided with a single induction heating unit.

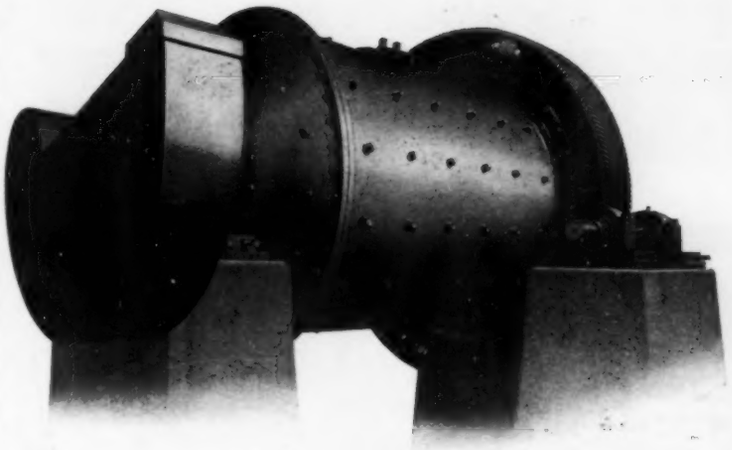
ANTIMONY ON BATTERY PLATES

PREVIOUS evidence against use of antimony as a constituent of the alloy used in storage battery construction has been based on theoretical electrochemical considerations or experiments on specimens of alloy. The author, J. W. R. Byfield, consulting engineer of New Zealand, undertook a series of comprehensive tests to establish beyond doubt that antimony leached from the positive grids during charge is electrodeposited upon and in the active material of the negative plates. The results were reported before the Electrochemical Society in Cleveland. Once this deposition takes place, it follows, owing to the electrochemical behavior of antimony in an acid solution, that local action or self-discharge is promoted to a degree which is at least proportionate to the quantity and distribution of the antimony.

Over 1,000 discarded batteries were dismantled during the tests, this number including 73 different makes of English, American, Canadian, Australian, New Zealand, and French manufacture. The tests showed that presence of antimony in the negative battery plates of the starting and lighting type is far in excess of any quantity of antimony which could possibly diffuse from the negative grid under ordinary circumstances. The antimony deposit has been found to be diffused throughout the pores of the plate as well as appearing on the surface of a plate where it is or can be rendered plainly visible. The deposit is present on all negative plates of the "Starting, Lighting, Ignition" battery types which have been in service for more than a few months or at most a year. The author believes that the ultimate answer to this problem of the deposition of antimony on negative battery plates must lie in a complete swing-over to the use of such alloys as the calcium-lead type for grids.

HEAT TRANSFER FILM COEFFICIENTS

STUDY OF heat transfer film coefficients for liquids in "Karbate" exchangers was reported upon by R. E. Zinn, H. G. Thoeming and C. G. Duncan-Clark of the Victor Chemical Works, Chicago Heights, Ill., before the American Institute of Chemical Engineers in Chicago. Using an impervious graphite



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SYMBOLS of DEFENSE

FEW American military emblems have a prouder battle history than the "YD" worn on the shoulders of New England's National Guardsmen. As the 26th, or "Yankee" Division, the New Englanders were one of the first Guard outfits to see action in World War I. In the great struggle of the Aisne-Marne, they were in line for fifteen days and lost more than 5,000 men. It was the aggressive "Yankees" who finally captured Belleau and held it in the face of a heavy three day artillery fire. In the Saint Mihiel operation they were active and in the Meuse-Argonne their deeds made Ville-devant-Chaumont an heroic name. During a service of 205 days in the front line, their casualties totalled 13,664 men. Today, the New England National Guard is in camp, preparing again to stand watch over American liberties.

INDUSTRY, TOO, must stand watch—with alert eyes on the foes of production. Foremost among these is corrosion. Among the corrosion resistant alloys developed by the Lebanon Steel Foundry, Circle L 23 is widely accepted because of its generally good corrosion resistant qualities combined with satisfactory physical characteristics. At Lebanon, this alloy is induction furnace melted. It and the other Lebanon alloys have made possible changes in methods and practice of far reaching economic value.

LEBANON STEEL FOUNDRY • LEBANON, PA.

ORIGINAL AMERICAN LICENSEE GEORGE FISCHER (SWISS CHAMOTTE) METHOD

LEBANON *Stainless and Special Alloy* STEEL CASTINGS

"Karbate" No. 2 tube 1 in. i.d. x 1.5 in. o.d. x 60 in., in a double pipe heat exchanger, overall heat transfer coefficients were determined for the case of water on both sides of the tube. Employing a modified method presented in the paper, the overall coefficient obtained from terminal temperature and heat balance data correlated closely with those calculated from the individual resistances, using recently published data and formulas. This method includes the recalculation of the coefficients from temperature gradients that have been proportioned according to the resistances obtained from the coefficient of the primary calculation. The overall heat transfer coefficient values range from 60–1,100.

On the basis of the correlation between the calculated overall transfer coefficient and experimental heat transfer coefficient values, the individual film coefficients for liquids other than water have been obtained, using the above recalculation method. The values of the film coefficients for 90 percent formic acid, nickel sulphate-sulphuric acid solution, and for 90 percent, 80 percent and 55 percent phosphoric acids, were given and represent heat transfer data not previously available, according to the authors.

CLEANING SAND

CLEANING of glass sand was discussed by John Dasher and Oliver C. Ralston, Eastern Experiment Station, Bureau of Mines, College Park, Md., before the annual meeting of the American Ceramic Society at Baltimore last March. Iron occurs in glass sand in discrete grains of iron-containing minerals and as a stain, usually containing clay, on the surface of the quartz grains. In the past, tabling and magnetie separation have been used to remove specks; and washing and acid leaching have been used to remove stains. For sands that do not respond to these treatments and for some sands that do, two new methods, attrition scrubbing and froth flotation, were proposed.

The attrition scrubber, which is just starting its sub-commercial development, is a small, compact, high-speed agitator which provides maximum turbulence that will rub off tough stains without breaking the sand grains. It is smaller than the motor that drives it. All parts are rubber-covered so that the sand grains rub only against each other.

Froth flotation, which is not new to ore dressing, will take out the heavy, magnetic specks that were removed by the old methods, and also other specks such as muscovite mica and iron-stained feldspar which the old methods do not remove. Although it provides sufficient agitation to remove soft stains such as those removed by washing, best results are obtained on sands which have been scrubbed to clean the surfaces so that a more selective separation may be made.

A MIGHTY LAZY LIQUID GETS A MOVE ON

THROUGH CUNO AUTO-KLEAN FILTERS

Atlas Powder Company, Zapon Division, Stamford, Conn., finds Cuno *continuously-cleanable* Auto-Klean Filters the answer to a tough problem in viscosity.

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Two Cuno Auto-Klean filters in series in each line, installed by Atlas, keep viscous pyroxylin (20,000 centipoises) continuously on "Go". Note the handles above each filter? A quick turn cleans filters *instantly, while in operation.* Another tough filtering problem solved by self-cleaning Cunos — in this case, with stainless steel internal parts.

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Cuno capacities cover a wide range, and many remarkable case studies illustrate what Cuno filters can do *wherever fluids flow.* Write today for free booklet, "80 Ways to Make More Money," showing how many industries have ended the "pause" that was depressing production and profits!

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SELECTIONS FROM FOREIGN LITERATURE

CLARIFYING INDUSTRIAL EFFLUENTS

SEDIMENTATION tests were carried out with wastes from two large plants in Sweden. In their content of dissolved salts and carbon dioxide and in pH these wastes were entirely different, with variability in each according to operating conditions in the plants. Consequently the sedimentation rate varied even for the same effluent when taken from different sewers in the same plant.

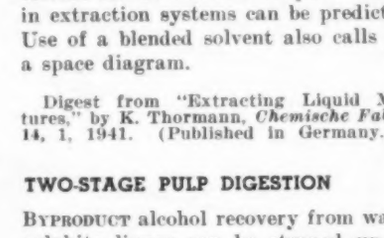
Among electrolytes used as coagulants, quicklime and aluminum sulphate were most effective. Starch is only a moderately effective clarifier, although potato starch is exceptionally potent in clarifying coal slurries. Radioactive water has a dispersing rather than a coagulating effect. For siliceous slurries a good accelerated settling effect is obtained by adding powdered limestone and grinding the slurry.

From tests in settling basins it appears that the manner of introducing the sewage is important. Piping the sewage into the basin near the bottom is preferable. Spraying the sewage over the surface is an inefficient method. More research is needed, for example, in changes of composition (whether in the water or in the suspended matter) which accelerate sedimentation.

Digest from "Sewage Settling in Basins," by G. G. Bring, *Jernkontorets Annaler* **125**, 1, 1941. (Published in Sweden.)

EXTRACTING MIXED LIQUIDS

CHOICE of a solvent or solvent blend for extracting one liquid from another depends on obtaining an effective immiscibility range within suitable temperature limits, with minimum expenditure of solvent under pressure and viscosity conditions permitting economical operation. In composition charts on triangular coordinates (extract, raffinate, solvent) the immiscibility range may or may not extend across the entire chart but its conodes (lines joining like points for two phases in equilibrium) must be such as to favor separation of extract and raffinate. Thus, if a conode when extended would intersect the solvent line at its apex the solvent cannot effect extraction beyond the point represented by that conode in the immiscibility range. If changing temperature shifts the direction of the conode, the system may be extractable by operating at two different temperatures. By charting the behavior of the solvent in temperature: concentration and pressure:concentration diagrams, favorable conditions can be ascertained for economical counter-current extraction coupled with efficient solvent recovery. The layout of a four-stage counter-current system is shown in the diagram, in which a = mixers, b = separators, c = condensers (for solvent vapor), d = fractionators for solvent recovery, M = liquid inlet, E = extract outlet and R = raffinate outlet. If a ternary system is to be extracted, the relations require a space diagram (tetrahedral coordinates). By plotting the vapor pressure conodes in such a diagram the behavior of a given solvent can be charted and performance in extraction systems can be predicted. Use of a blended solvent also calls for a space diagram.



Counter-current liquid extraction

Digest from "Extracting Liquid Mixtures," by K. Thormann, *Chemische Fabrik* **14**, 1, 1941. (Published in Germany.)

TWO-STAGE PULP DIGESTION

BYPRODUCT alcohol recovery from waste sulphite liquor can be stepped up by lowering the lime content of the liquor, but only at the expense of losses both in yield and quality of pulp. To permit higher alcohol recovery and still maintain pulp yield and quality Hägglund developed a two-stage digestion method which avoid the damaging acidity increase at the end of a single stage digestion with liquor having a low lime content.

The new process operates with liquor containing only about 0.4 or 0.5 g. calcium oxide per 100 cc. but withdraws the liquor when the sugar content is high and completes the digestion with fresh liquor of about the same lime content. Success depends on making the change while the chips are still strong enough not to disintegrate while the first liquor is draining off. The sulphur dioxide content of the first stage liquor must be rela-

Improvement of alcohol yield by two-stage digestion of wood pulp

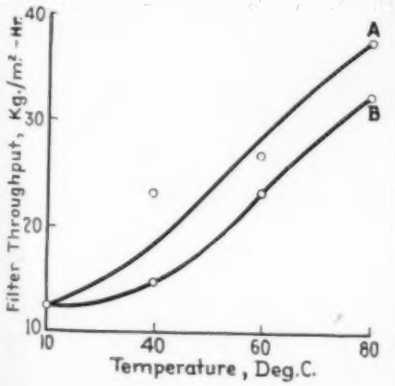
Liquor CaO content g. per 100 cc.	Pulp				Yield of Absolute Alcohol liters	
	Yield percent	Tearing length km.	Bursting factor	Tearing strength g.	Per cu. m. of waste liquor	Per ton of pulp
			Single Stage Digestion			
1.0	47.5	9.0	58	92	14.0	54
1.3	50	10.5	72	82	10.1	37
			Two Stage Digestion			
0.4	(49)	9.0	58	91	10.8	112
0.5	48.5	9.0	62	90	10.0	94
0.6	49.5	10.0	68	86	9.0	85
0.7	50	10.5	73	83	7.0	66

tively high so that adequate sulphonation will be effected. The same sulphur dioxide concentration (about 6 g. per 100 cc.) may be preferable in the second stage also, though not needed, since only one composition of liquor needs to be prepared and handled. The table on the opposite page illustrates how pulp yield and quality are maintained while alcohol recovery is doubled, or better. This table refers to pulp with Roe number 4.

Digest from "Study of the NAF-Hägglund Two-Stage Sulphite Digestion Process," by Hugo Nihlen, *Zellstoff und Papier* 21, 67, 1941. (Published in Germany.)

ACCELERATED FILTRATION OF SLURRIES

SLURRIES of kaolin, ground cement clinker, lignite or ceramic slips can be filtered much faster with the aid of certain filtration accelerators than alone. The final result of the filtration is not impaired in any way, but the operation is speeded up sometimes to as much as four times the original rate. Starch and gelatin are effective accelerators in small concentrations but it has been found that konjak flour is four to five times more potent. As little as 10 parts of konjak flour per million parts of slurry solids greatly increases the rate of filtration. Adding 50 g. konjak flour per metric ton of solids in a slurry gives from 50 to 300



Temperature influence on filtration rates of a stoneware composition with 0.02 percent of konjak flour added: (A) To the hot slurry before filtering; (B) Before heating the slurry

percent increase in rate of filtration. No such acceleration can be gained by high temperature filtration. Even at 80 deg. C. (a filtration temperature which would be impossible in practice) filtration of cement clinker dust is slower than when 0.001 percent of a good accelerator is added.

Digest from "Accelerating Filtration by Modifying the Slurry," by Horst Rumpelt and Ilse Schween, *Chemische Fabrik* 13, 481, 1940. (Published in Germany.)

OILPROOF PLASTICS

LAMINATED (hard paper) sheet products, some made with phenolic and some with urea resins, have been tested for resistance to benzene, a standard gasoline, a blended motor fuel, "Aeroshell"

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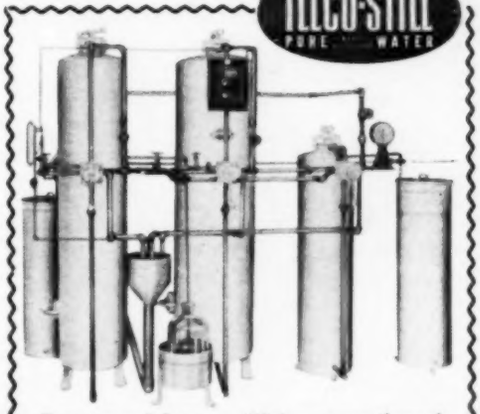

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Operation— Water passes through two reactor tanks. A chemical reaction in first tank removes positive ions, such as calcium, magnesium, and iron, substituting hydrogen. Water then passes to second tank where the hydroxyl (OH) ion is substituted for negative chloride and sulphate ions, etc. This OH ion then combines with hydrogen to form H_2O. The minerals removed from water are retained in reactor tanks until flushed to drain. Treated water contains small amounts of dissolved dioxide gas which can be dispelled easily by aeration.

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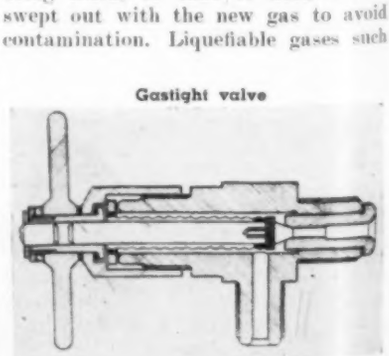
and "Shell 4X" oil at 70 deg. C. The two heavy oils were also tested at 105 and 140 deg. C. It was found that in general there is more weight loss (resin extraction) from the laminated sheets made with urea resins than from those made with phenolic resins. With both types of resin, however, there is considerable variability and the test results indicate that products with high resistance to motor fuels and petroleum oils can be developed with either type of resin by selective formulation and by proper attention to processing details. Changes of dimensions of exposed test pieces were so small as to be negligible for practical purposes and the results were judged entirely on the weight loss basis. Test pieces 10 x 50 x 1 mm. in size were immersed 104 hr. in the selected solvent and weighings were made at eight-hr. intervals. Weight losses ranged from about 0.5 to about 6 percent. In the tests with benzene the best of the urea resins lost 1.5 percent in weight while the phenolic resins were not markedly superior to the best of the urea resins but showed less variability. Superiority of the phenolic resins was more evident in the tests with gasoline, "Aeroshell" and "Shell 4X" but in the high temperature tests even the best of the phenolic resins lost about 4 percent in weight. By comparing the composition and properties of the resins showing greatest resistance to oils it is expected that substantially oilproof products can be formulated.

Digest from "Action of Motor Fuels and Oils on Laminated Sheets," by W. Paul, *Kunststoffe* **30**, 142, 1940. (Published in Germany.)

NEW GASTIGHT VALVE

INCREASING severity of purity specifications for industrial gases has emphasized the leaky nature of ordinary valve packings and necessitated improvements in valve construction. A new valve, designed by the chief instrument maker at the Kaiser Wilhelm-Institut für physikalische Chemie und Elektrochemie, utilizes metal tubing to prevent contamination of pure gases by leakage. Metal tube valves are not in themselves novel, but the new valve has a novel combination of structural features. A readily replaceable flat fiber disk is used for packing, and the valve seat is also replaceable. When this valve is used the steel cylinder can be thoroughly evacuated before being filled, so that it need not be swept out with the new gas to avoid contamination. Liquefiable gases such

Gastight valve



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They are made of De-Aired (Vacuumized) and Electrolyzed Clays, vitrified at 2,500° F. and are exceptionally strong and tough, with walls of uniform shape and thickness.

They offer maximum resistance to solvents, alkalies and acids (except hydrofluoric acid), including hot oxidizing agents.

They will withstand extreme and sudden thermal shocks, and will not chip, spall or crumble.

They are non-absorbent, non-corrosive and non-porous.

Raschig Rings are made in both Chemical Stoneware and White Porcelain in all sizes from ¼" O.D. up.

Prompt shipments from stock.

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as hydrocarbon fuel gases can be charged directly into steel cylinders by low temperature distillation without any contamination with air. Gas losses and accompanying toxicity or fire hazards are avoided because escape of gas through leaky stuffing boxes of ordinary valves is avoided. Accidental contact of the valve seat packing with oil is impossible, a feature which is particularly important in handling compressed oxygen. Because of its strength and compact construction this valve can be used for ordinary handling of any compressed gas in cylinders, even under severe mechanical stresses.

Digest from "A New Metal Tube Valve," by R. Schultze, *Chemische Fabrik* **13**, 417, 1940. (Published in Germany.)

SPINNING ACETATE SILK

DIRECT wet spinning of acetate silk filaments into a coagulating bath of sodium acetate and acetic acid gives best results when the bath contains 10-20 percent of acetic acid and 20-30 percent of sodium acetate. This has been demonstrated by a study of the relations between bath composition and fiber properties. It was found that the acetate acts as an active coagulant while the acid serves, through its solvent power, as a buffer between excessively fast and excessively slow coagulation. In a bath containing 20 percent sodium acetate the tensile strength of the filament decreased when acetic acid concentration was below 10 or above 15 percent, the length of coagulation bath being 80 cm. and spinning speed 10 meters per min. This tendency is also illustrated by the table, taken from tests under the same conditions excepting that the bath contained 30 percent sodium acetate.

Tabulated data are also presented to show the influence of acetylation conditions and spinning conditions on fiber properties.

Variation of acetate silk properties with varying concentrations of acetic acid in the coagulating bath; 30 percent sodium acetate present in all cases

Acetic acid percent	Fineness, deniers	Tensile Strength, g. per denier	Elongation percent
0	10.5	1.15	44.1
10	8.93	1.77	31.8
15	9.10	1.52	15.9
20	9.48	1.60	16.1
30	7.76	1.22	20.5

Digest from "Spinning Acetate Silk: Direct Wet Spinning," by T. Araki and S. Tadenuma, *Journal of the Society of Chemical Industry, Japan* **44**, 52B, 1941. (Published in Japan.)

PHOSPHATING METAL SURFACES

THE FILM of tertiary zinc phosphate applied to iron or steel in modern accelerated phosphation can be made thick or thin by controlling the rate of seed crystal formation and growth. Growth of the film follows the diffusion law. Control may be exercised by several methods, some physical and some chemical. The electron diffraction method of investigating film growth

QUICK-SETTING ACID-PROOF CEMENTS

"VITRIC-10" Quick-Setting Acid-Proof Cement hardens by internal chemical set into a strong, acid-proof, granite-like structure of permanent durability, the initial set occurring in 25 to 30 minutes.

"PRE-MIXT" Acid-proof Cement comes in powder form and requires only mixing with water on the job. For convenience and general utility "Pre-Mixt" is unequalled.

"SUPER-VITRIC" hardens throughout the mortar joint by chemical reaction rather than evaporation and forms a dense, porcelain-like structure of minimum porosity.

Write for bulletins describing our new "Resilon" and "Tygon" Corrosion Resistant Tank Linings.

"U. S. Stoneware" Acid-Proof Cements adhere strongly to brick, steel, glass, lead and rubber and make acid-proof masonry construction ready for use in two or three days.

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PRESERVATIVE
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ALDEHYDE REACTANT

TODAY it is well to consider the adaptability of Furfural to your production. It has many properties common to aldehydes, and in addition possesses unique characteristics introduced by the Furan ring. Conditions now invite a re-examination of the uses based upon its aldehyde properties.

Furfural

Here are typical values determined on the commercial product, available in cans, drums, drum-carloads, and tank cars:

Boiling range (99%)	157–167° C.
Specific gravity (20/20)	1.161
Flash point (open cup)	56° C.
Surface tension (dynes/cm.)	49
Viscosity at 38° C. (centipoises)	1.35
Water solubility at 20° C.	8.3%
Color	Light straw to amber

Information about the use of Furfural is supplied gladly on request. Ask for your copy of the new Booklet entitled THE FURANS and pictured on this page. It contains information about Furfural, its derivatives, and their uses.

The Quaker Oats Company
TECHNICAL DIVISION 5-6
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FURFURAL - FURFURYL ALCOHOL - HYDROFURAMIDE
... TETRAHYDROFURFURYL ALCOHOL ...

is expected to yield useful information in this respect. As a crystal layer with many capillaries and interstices, the phosphate film has a capacity for absorbing organic substances which can be utilized to increase the protective effect. Lacquering is best for thin films, while thick films readily absorb oil vehicles. The organic coating is benefited in two ways by the phosphate film, namely in adhesion and in prevention of under-film rusting. Phosphation is most effective when applied to finished parts, since the film has only limited ability to withstand shaping and forming operations. An exception, however, is cold drawing, which is facilitated by phosphation. Aside from its rustproofing effect, phosphation reduces metal-to-metal friction in ball bearings and other parts.

Digest from "Surface Treatment of Metals by Phosphation," by Gerhard Roesner and Ludwig Schuster, *Chemische Fabrik* **14**, 6, 1941. (Published in Germany.)

ACTIVATED SLUDGE TREATMENT OF SOYBEAN WASTES

RAW waste from a factory producing artificial fibers from soybean casein was experimentally treated with activated sewage sludge. The effluent was acceptable, as to biological oxygen demand and suspended solids content, for discharge into streams. Purification was next tried with activated sludge derived from the waste itself. This sludge was made either by aerating the raw waste a week, settling two hr., discarding the supernatant liquid and adding fresh waste for another week of aeration, or by similar four-day aeration periods of waste mixed with 20 volume-percent of settled raw sludge, or by pre-aerating raw waste two days, seeding with one percent of activated sewage sludge, aerating eight hr. and discarding the supernatant liquid without settling. The last method proved best, yielding an amber-yellow activated sludge (30 volume-percent in two weeks) and a clear sparkling supernatant liquid. Soybean waste purified with this activated sludge yielded 2.4 tons of dry digested sludge which gave by distillation 1,116 cu. m. of fuel gas, 0.196 ton of fuel oil, 0.131 ton of ammonium sulphate and 0.853 ton of residual coke, for each 10,000 tons of raw waste.

Digest from "Studies on the Disposal of Industrial Wastes: Purifying Soybean Waste by the Activated Sludge Process," by Saburo Shibata, *Journal of the Society of Chemical Industry, Japan* **44**, 68B, 1941. (Published in Japan.)

CATALYTIC GASOLINE SYNTHESIS

IT HAS been found that carbon dioxide in the effluent gas is a powerful catalyst poison in the synthesis of gasoline from carbon monoxide and hydrogen at ordinary pressure over an iron-copper catalyst. For experimental purposes two catalysts were tested, one made with Fe + 25 percent Cu + 125 percent diatomaceous earth + 2 percent KOH while the other was the same excepting that it also contained

2 percent Mn. The tests showed that catalyst life and gasoline yield are impaired by increasing carbon dioxide content while the optimum amount of added alkali (acting as promoter) becomes greater. At least part of the catalyst poisoning effect is due to inactivation of the promoter (KOH) by carbon dioxide. As carbon dioxide content increases in the effluent gas it becomes necessary to decrease the gas flow rate and hence the output capacity of the catalyzer. Since carbon dioxide is a common impurity in the effluent gases from the gasoline synthesis its poisoning action on catalysts must be minimized or eliminated for efficient production. The Fe: Cu and Fe: Cu: Mn catalysts used in these tests represent a substantial improvement but more research is needed to develop catalysts capable of maintaining gasoline yield against carbon dioxide and other possible poisons in the effluent gases.

Digest from "Gasoline Synthesis from Carbon Monoxide and Hydrogen. 54. Influence of Carbon Dioxide in the Effluent Gas on the Iron Catalyst," by Y. Murata and T. Yamada, *Journal of the Society of Chemical Industry, Japan* 44, 33B, 1941. (Published in Japan.)

CIRCULATING SULPHITE LIQUOR

CIRCULATION of the digestion liquor in making sulphite pulp has advantages which are now generally recognized and are even considered essential in the manufacture of cellulose for rayon or staple fiber. But the optimum effects of circulating liquor are obtained only if the following conditions are met:

1. To avoid vibration the liquor must be preheated outside the digester. Indeed, the ceramic lining and metal shell of the digester cannot be fully protected from vibration unless they are entirely free from steam line connections.

2. For the same reason connections from the preheater to the digester must be elastic, to absorb oscillations and shock, and the liquor pump must operate smoothly without bumping.

3. The main direction of liquor flow in the digester must be upward from below for the sake of uniform, rapid penetration of the wood and for maintenance of circulation throughout the operation. Rest periods (intermittent circulation) need not be provided.

4. Even heat distribution throughout the digester must be effected much more rapidly and thoroughly than can be accomplished by heating the liquor in the digester, even with indirect heat.

5. The amount of liquor circulated in unit time must be ample throughout the digestion period.

Not the least of the advantages offered by preheating and circulating sulphite liquor is that corrosion and erosion of the digester walls are lessened, especially the cavitation which accompanies heating with superheated steam.

Digest from "Circulating Sulphite Liquor in Digesters," by Wilhelm Abele, *Zellstoff und Papier* 21, 51, 1941. (Published in Germany.)

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HOMESTEAD LEVER-SEALD PLUG VALVES

Temperature and pressure extremes, infrequent operation, the handling of viscous fluids, and other conditions that cause ordinary valves to "stick" or "freeze," simply do not affect the operation of Homestead LEVER-SEALD Plug Valves! They **always** work!

The sound engineering principle that makes possible this remarkable performance is only one of many advantages which include quarter-turn opening or closing, protected seating surfaces, straight-line flow, and a leakless seal without lubrication.

Add to these, a choice of metals and alloys for longest service at lowest cost-per-year, and you have the ideal valve for the majority of your jobs. Write your needs for recommendation.

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The ancient Archimedian principle of the lever and screw, applied to the modern engineering of Homestead Lever-Seald Valves, assures a pressure-tight seal **without lubrication,** plus positive operation under all conditions. This powerful leverage multiplies a small operating force many, many times. Thus it gives extra ease of opening or closing the valve under the toughest service conditions; and every means for assuring this positive operation is **right on the valve at all times.**

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PROTECTED-SEAT VALVES: HYDRAULIC (5 & 6 PAR.) OPERATING, REMOTE CONTROL, HYDRAULIC DESCALING, BOSS AIR SHUT-OFF VALVES, MOVALCO BLOW-OFF VALVES

PARTICLE SIZE... FLOW RATE...CLARITY

Some Questions and Answers on Filter Aids that will help you cut clarification costs

1. What type of diatomaceous silica crude provides the best filter aids?

For filtration purposes, diatomaceous crude first must be relatively free from soluble and insoluble impurities. Of equal importance, it must contain the right types of diatom particles in the proper proportion of different shapes and sizes.

2. Why are particle shape and size so important?

Because only from crude of this type has it been possible to produce filter aids which have the proper gradation of sizes and a great diversity of irregular shapes. Filter aids of this type build up on the filter cloth the intricately interlocking porous structure necessary to provide rapid and complete clarification.

As a filter cake builds up, the microscopic diatom particles form a lattice-like structure within which the impurities collect and are entrained. When the proper filter aid is used for a given type of liquid, the filter cake will be of such nature as to prevent the trapped impurities from being swept through the capillary channels, while offering minimum resistance to the passage of the clarified liquid.

3. Why have some filter aids higher flow rates than others?

This is principally a function of gradation of particle sizes. Generally speaking, the coarser the particles, the larger the pore openings and channels in the filter cake, and the faster the flow rate.

4. How is pre-determined particle size obtained in manufacturing filter aids?

In the faster flow-rate products, calcination and chemical treatment fuse the smaller diatom particles together into larger, yet still microscopic, particles. Virtually any particle size, or any gradation of particle size desired, can be obtained within remarkably close limits by varying the heat and chemical treatment and subsequent processing.

5. What is the effect of flow rate on the clarity of the finished filtrate?

Naturally, the faster the flow rate, the coarser the screening action. Whether clarity suffers depends upon the size and type of suspended matter to be removed. Liquors containing only relatively large-sized impurities can be completely clarified with a fast-flow-rate filter aid. Others with very small colloidal impurities require one of the slower, finer particled filter aids to assure satisfactory clarity in the finished product.

6. How can the most satisfactory and economical filter aid be determined?

The proper filter aid to use is the one that will give the required clarity with the highest flow rate. While filtration engineers know the grade of filter aid which will normally give the best results for a given type of liquid, no two filtration operations are exactly alike. Thus, the only sure way of determining the most efficient and economical filter aid is by actual plant tests.

7. How can Johns-Manville help in cutting filtration costs?

First, there are ten J-M Celite Filter Aids, each with a different particle size. These ten materials will form filter cakes having ten different pore structures and providing a diversity of flow-rate and clarity characteristics from which to choose the right material for any filtration requirement.

Second, these Celite Filter Aids are produced from the Lompoc, California, deposit, long noted for its unusual purity and for the fact that it contains the most favorable proportions of various diatom shapes for filtration purposes. This huge deposit is owned and operated by Johns-Manville.

Third, Celite Filter Aids are always uniform, a result of virtually inexhaustible deposits of high-quality crude, the most advanced processing methods and equipment, and extreme care maintained throughout every stage of manufacture and inspection.

Fourth, Johns-Manville Filtration Engineers have had many years of technical training and practical experience, not only in the application of filter aids, but in every other phase of filter operation as well. In hundreds of plants where the clarification process seemed satisfactory, they have been able to help increase production, lower costs and improve the quality of the finished products.

And Fifth, the Johns-Manville Filtration Laboratory, where modern filtration methods and today's high-flow-rate filter aids were developed, is always available for the solving of new or unusual clarification problems.

If you are not now using J-M Celite Filter Aids or availing yourself of the J-M Filtration Engineering Service, may we give you further details? Johns-Manville, 22 East 40th Street, New York, N. Y.

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Filter-Cel . . . Celite No. 505 . . . Standard Super-Cel . . . Celite No. 512 . . . Celite No. 536 . . . Hyflo Super-Cel . . . Celite No. 501 . . . Celite No. 503 . . . Celite No. 535 . . . Celite No. 545

give maximum flow rates with required clarity on every filtration service

New Titles, Editions and Authors

Chem & Met BOOKSHELF

FROM SKIN TO LEATHER

MODERN PRACTICE IN LEATHER MANUFACTURE. By *John A. Wilson.* Published by Reinhold Publishing Corp., New York, N. Y. 744 pages. Price $9.50.

Reviewed by *Fred O'Flaherty*

THIS book is a text with a very definite purpose concerning a most essential subject. There are available to the layman some few but incomplete books on tanning and leather; there is also a fair number of technical books on the subject yet they are none too recent in their publication and generally limited in their scope. For the persons casually interested in leather or its manufacture or non-technical personnel engaged in the tannery there have been no suitable sources of information.

In the present work the author has founded every statement upon sound scientific facts, the references of which are given. In addition he has expressed in simple and concise terms an interpretation of every phase of leather manufacture from a consideration of raw material to the finished leathers of many varieties.

The micro structure of all varieties of skins, hides and leathers is illustrated by photomicrographs and adequate word description. This chapter should stimulate a keen interest in the microscope's application by technical men as well as the amateur microscopist.

Chapter II is filled with a store of information on the handling of skins and hides before they arrive at the tannery. This is a subject seldom considered by the tannery technical staff and yet it is information which has a direct bearing on tannery operations. Any one with an interest in leather will profit by reading this chapter.

In Chapter III is information on which even those engaged in the tannery are poorly acquainted, and it should give to any one a broad picture of the many variety of leathers being made today.

Chapter IV gives a full and detailed discussion of hide and skin disinfection and is the first text to contain the details of the new disinfectant methods developed by the Tanners' Council Laboratory and which have proved so highly economic as well as efficient.

Hide and skin damages are thoroughly covered in the next chapter. This is enlightening and may well aid in the correction of many such conditions so costly to the general public as well as the leather industry.

Hide market facts are set forth in the succeeding chapter and while it may be no guide to the seasoned skin and hide buyer it should give a clearer picture of this important phase of leather manufacture.

The next chapters guide the uninformed through the preparation for tanning. The importance of these next 3 chapters can best be appreciated by the persons interested in leather manufacture by the well established axiom, "Good leather is made in the beam house."

In the chapters on tanning proper there are recorded for the first time specific instructions on every step of tanning whether chrome, vegetable, formaldehyde or the combinations. These chapters also include much information on the synthetic tanning materials. Especially of interest to the industry is the detailed information on calgon tannages which include formulas never before published.

The lubrication of leathers is treated both as a fatliquoring operation and as an oiling process. Of particular interest is the use of phosphated oils which the author describes fully.

The finishing operations are also well covered with every variety of leather being considered separately.

With all these word descriptions the book is most profusely illustrated and even to one who has had long and close association with the leather industry there is a vast store of interesting information.

This book should be in the hands of every tanner and should find ready every day usage by his technical as well as administrative personnel. It is recommended for any one who is anxious to learn about leather and its manufacture.

AIR-CONDITIONING

MODERN AIR CONDITIONING, HEATING AND VENTILATING. By *W. H. Carrier, R. E. Cherne* and *W. A. Grant.* Published by Pitman Publishing Corp., New York, N. Y. 538 pages. Price $4.50.

Reviewed by *T. R. Olive*

BEFORE reading this long-heralded contribution from the pen of Dr. Carrier and his collaborators, the reviewer seriously questioned the need for still another book on air conditioning. Therefore it is a pleasure to report that this is not "just another book" on the subject. It is definitely superior to the earlier literature, filling in many gaps from the extensive experience of the authors' company. Much previously unpublished information has been taken from the company's files and included for the benefit of the profession. Largely, this new information is of a sort that can be discovered only from experience and is omitted entirely or glossed over in earlier books and in the periodical literature.

Necessarily, for the sake of completeness, Dr. Carrier has included a good many tables and charts taken from readily available sources such as manufacturers' literature and the "Heating, Ventilating and Air Conditioning Guide." He has also followed earlier authors in the inclusion of many solved problems and to some extent the method of treatment is similar. However, these comments should not be considered as adverse criticism since the boiled-down experience factors included more than offset any sameness that may be noted. If the engineer could have but one book on air conditioning, the reviewer believes this is the one.

Naturally, a book aimed primarily at the heating, ventilating and air conditioning profession, leaves something to be desired from the standpoint of the chemical engineer. For example, it is disappointing to find that the chemical engineer, William M. Grosvenor, still receives no credit for his publication in 1908, three years before the appearance of Dr. Carrier's "Rational Psychrometric Formulae," of what is substantially the basis of modern air conditioning. Then, as the editors of *Chem. & Met.* discovered in 1940, in the preparation of their "Report on the Conditioning of Gases and Air" which appeared in the May 1940 issue, the air conditioning engineer's approach to such problems is not entirely suitable when a vapor other than water, or a gas other than air is involved. Finally, it is a little disconcerting in this day and age to find a large number of chlorine compounds mentioned by chemical formula, with chlorine expressed as "Cl."

Still, from the standpoint of use of the new book, these comments are obviously minor. For the mass of hitherto unavailable information included, Dr. Carrier and his collaborators deserve the thanks of all engineers, a great many of whom will find this important work a decidedly valuable addition to their libraries.

NON-FERROUS METALS

NON-FERROUS PRODUCTION METALLURGY. By *John L. Bray.* Published by John Wiley & Sons, New York, N. Y. 430 pages. Price $4.

Reviewed by *J. J. Jacobs, Jr.*

A COMPREHENSIVE survey of the production of non-ferrous metals is herein presented in a clear style, suitable for use as a text or as a reference.

The introduction and chapters on

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Here is one of the world's greatest construction accomplishments of all time . . . *and a job where no compromise can be made with inferior equipment.* That's why *BECKMAN Automatic pH Instruments* — exclusively — have been installed to control — *automatically and continuously* — pH in the various stages of the water treating process of this vast project.

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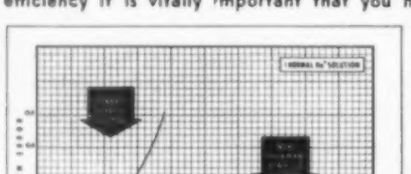
Regardless of the size or scope of your water treating problems, for the utmost efficiency it is vitally important that you have operating features like these . . .



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HIGH pH ELECTRODES for accurate measurement of pH in alkaline solutions—*even in the presence of sodium ions* . . . definitely a necessity for many process and boiler feed water treatments. *Only BECKMAN pH equipment gives you this major advancement!*

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A set of nine charts for heavy chemicals such as Sulphuric Acid, Oleum, Nitric Acid, Hydrochloric Acid, Phosphoric Acid, Soda Ash Solutions, Potassium Carbonate Solutions and Aqua Ammonia, together with an article on graphical calculation of mixed acids, and a transparent straight edge to use as a guide with the charts.

These charts were prepared for "Chem. & Met." by Prof. Ernst Berl, Research Professor at Carnegie Institute of Technology. Price . . 75¢

★

CHEMICAL & METALLURGICAL ENGINEERING

330 West 42d Street,
New York, N. Y.

metals and ores, and on slags and fluxes are given excellent treatment. Particularly are the precise definitions of terms used of value, as the confusion of metallurgical terms is sometimes a major handicap of the uninitiated.

The author covers the metals in alphabetical order rather than in the order of production amounts or chemical, physical or metallurgical relationships. From the student's standpoint, a drawback is the lack of problems or review questions at the end of the chapters, which would have to be supplied by the instructor.

A very helpful and logical order is followed in the discussion of each metal. Every chapter uses the following sequence: history of the metal, economic situation, properties of the metal, marketing and prices, uses, ores in which the metal is found. After this important introductory material, the actual technical details of the production of the metal from its ores is taken up. Excellent line drawings, flow sheets and graphs of data serve to illustrate the descriptive material. The many types of machinery and methods used in these and other chemical engineering processes are well delineated. An important feature is the inclusion of completely described operation diagrams of important, named, representative smelters showing all processes, flow of materials, temperatures, etc., for these individual plants.

On the whole, the author has contributed a very concise and yet complete presentation of the subject matter covered by the title, and includes a good index and carefully selected list of references after each chapter.

PROCEEDINGS OF THE FORTY-THIRD ANNUAL MEETING. Published by the American Society for Testing Materials, Philadelphia, Pa. 1396 pages. Price $8.50 (paper), $9 (cloth), $10 (half-leather).

VALUABLE data and information on the properties and tests of engineering materials are issued annually in the published proceedings of A.S.T.M.'s annual meeting.

Reports of 52 committees give details of important recommendations on specifications and standardized test methods. The section devoted to technical papers constitutes the major portion of the volume. A considerable portion of these papers relate to metals, ferrous and non-ferrous. Several papers relate to questions of corrosion, materials at high temperatures, lead cable sheathing, and anodic coatings. Among the more important papers on non-metallics are those concerning concrete creep and volume changes, asphalt tests, oxidation of mineral insulating oil, and accelerated weathering of transparent plastics.

Also included is the fifteenth Edgar Marburg lecture. This was delivered by P. H. Bates of the Bureau of Standards whose subject was "Portland Cement—Theories (Proven and Otherwise) and Specifications."

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Non-slip, sharp top edge, self-cleaning cross bars like the ridge of a roof give you the maximum in safe traction. Other features your Batesgrate dollars buy are—maximum open area for light and air—no grooves or rough burned metal to catch grease or dirt—fillet weld, the strongest type—no cracks, joints, or crevices, therefore, easily maintained—smooth, clean appearance. Get all the important details from Catalog No. 937—Write today.

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RECENT BOOKS and PAMPHLETS

Defense Job Training. A condensed chart-guide to defense-training opportunities in program sponsored by Federal agencies. Covers 24 training programs including vocational training for persons who have never had a job and advanced training for persons now at work. Information given includes wages, fees, purposes, eligibility, and data on courses given. Chart is 18 by 23 inches and may be obtained from the Superintendent of Documents, Washington, D. C. Price 5 cents.

Fertilizer Prices and Price Indexes. By Herbert Willett. Published by National Fertilizer Association, Investment Building, Washington, D. C. This is the third edition of the very convenient reference leaflet by N. F. A. as "a summary of available information on fertilizer price levels, trends and relationships."

Industrial Controlled Atmospheres. N. K. Koebel. Privately printed for Lindberg Engineering Co., Chicago, Ill. 71 pages. Price $1. A study of the commercially available atmosphere control methods made for the purpose of determining which of the types of atmosphere should be used in a contemplated new heat-treating department forms the basis for the material in this book. Among the subjects discussed are History of Controlled Atmospheres, Determining Carburization and Decarburization, Older Methods of Atmosphere Controls, Theory of a Good Atmosphere, Scale-Free Atmosphere, and Relation of Furnace Design to Atmosphere. Well-illustrated with charts and photomicrographs.

Inventory Control Methods. Prepared by the Metropolitan Life Insurance Co., New York, N. Y. 45 pages. An exposition of inventory control systems, pricing methods, records, and adjustment procedure. An appendix describes the "Last in—First out" inventory method for Federal income tax purposes.

Spectrochemical Abstracts, Vol. II, 1938–1939. By E. H. S. van Someren. Published by Adam Hilger, Ltd., London. 38 pages. In two parts: authors and references arranged alphabetically under authors' names, and abstracts. The second part includes sections on substances analyzed and elements determined, apparatus, methods and accuracy, theory and principles, general reviews, and books and tables.

Beneficiation by Flotation of Willamette Valley Limestones of Oregon. By J. B. Clemmer and B. H. Clemmons. A joint report of the U. S. Bureau of Mines and Oregon State Department of Geology & Mineral Industries. Available only from the Department of Geology and Mineral Industries, 702 Woodlark Building, Portland, Oregon. Price 10 cents.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated, pamphlet is free and should be ordered from bureau responsible for its issue.

The Entropies of Inorganic Substances, by K. K. Kelley. Revision (1940) of data and methods of calculation. Part IX to Contributions to the Data on Theoretical Metallurgy. Bureau of Mines, Bulletin 434; 15 cents.

Marketing of Barite, by Bertrand L. Johnson. Bureau of Mines, Information Circular 7149; mimeographed.

Minerals Data. Preprinted chapters from the Minerals Yearbook which reviews 1940 operations of the mining and mineral industries are now being published by the Bureau of Mines. Those desiring individual pamphlets can procure them at 5 cents each from the Government Printing Office. In general it is safe to assume that new chapters will be issued during the period May to August on practically all of the subjects for which chapters appeared in the last Minerals Yearbook.

Preliminary Mineral Data. Continuing its policy of earlier years, the Bureau of Mines is issuing in mimeographed form "Mineral Market Reports," giving preliminary figures on commodities for which later chapters will be prepared for the Minerals Yearbook. (See paragraph just preceding). These preliminary mimeographed statements are available direct from the Bureau of Mines. Requests to them should specify the commodities of interest, so that the Bureau may accommodate inquirers promptly when each separate item has been issued.

Nonmetallic Minerals Needed for National Defense—Fertilizer Materials, by Bertrand L. Johnson. Bureau of Mines Information Circular 7159; mimeographed.

Home Insulation, an Effective Conservation and National Defense Measure, by Paul M. Tyler. Bureau of Mines, Information Circular 7166.

Cationic Reagents in the Flotation of Silica from Gypsum Ores, by J. Bruce Clemmer and F. D. DeVaney. Bureau of Mines, Report of Investigations 3553; mimeographed.

Carbonaceous Cation Exchangers from Coal and Coal Refuse, by S. J. Broderick and Dale Bogard. Bureau of Mines, Report of Investigations 3559; mimeographed.

Influence of Expanding Construction on Shipments of Building Materials, by Shirley F. Colby. Bureau of Mines, Information Circular 7157; mimeographed.

Dust-Explosion Hazards in Plants Producing or Handling Aluminum, Magnesium, or Zinc Powder, by Hylton R. Brown. Bureau of Mines, Information Circular 7148; mimeographed.

Beehive and Byproduct Coking in Washington, by Joseph Daniels. Bureau of Mines, Report of Investigations 3551; mimeographed.

Physical Characteristics of Some Low-Grade Manganese Ores, by R. E. Head. Bureau of Mines, Report of Investigations 3560; mimeographed.

Limits of Inflammability of Butadiene in Air, by G. W. Jones and R. E. Kennedy. Bureau of Mines, Report of Investigations 3565; mimeographed.

Progress Report on Exploration of Tin Deposits, by Mining Division. Bureau of Mines, Information Circular 7154; mimeographed.

Comparison of Manganese Steel with Carbon Steel for Detachable-Bit Drill Rods, by Wing G. Agnew. Bureau of Mines, Report of Investigations 3566; mimeographed.

The Mineral Industry of Alaska in 1939, by Philip S. Smith. U. S. Geological Survey, Bulletin 926-A; 20 cents.

Phosphate Investigation in Florida, 1934 and 1935, by P. V. Roundy. U. S. Geological Survey Bulletin 906-F; 30 cents.

A Test of Lens Resolution for the Photographer, by Irvine C. Gardner. National Bureau of Standards, Circular C428; 40 cents.

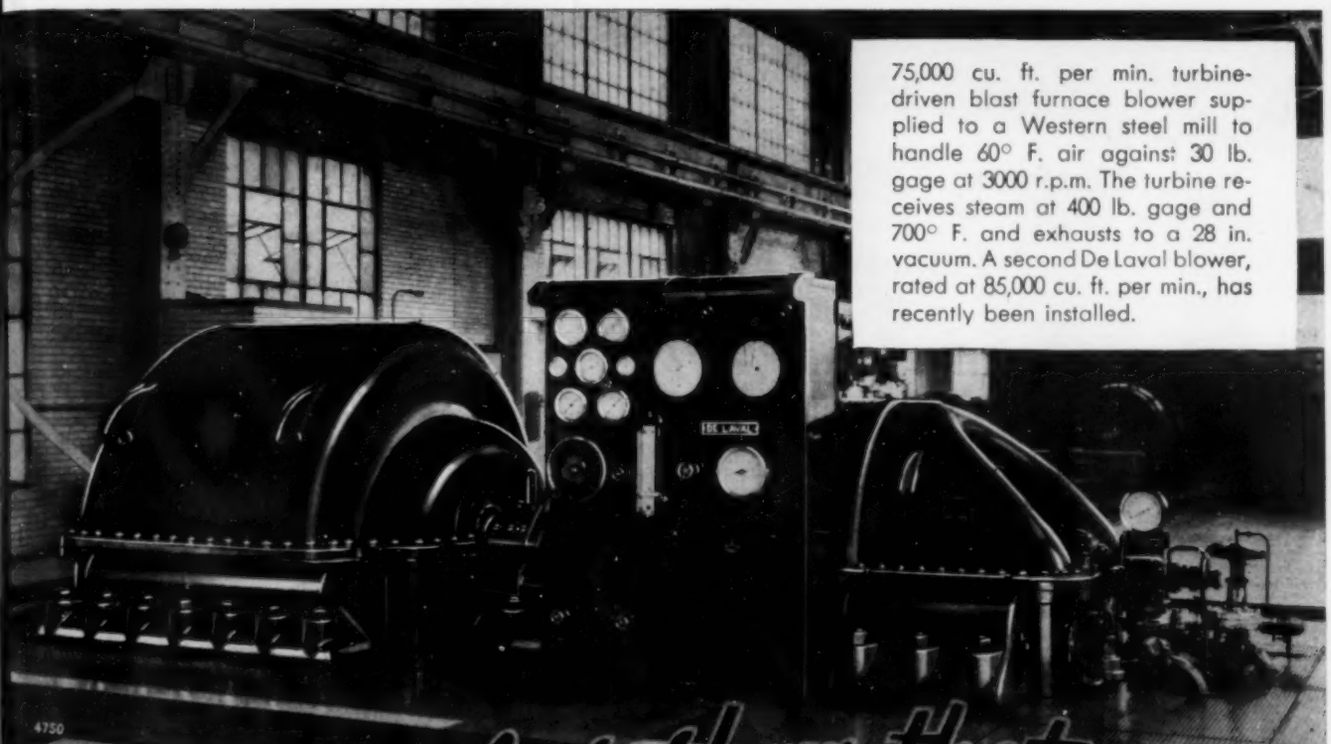
Performance Test of Floor Coverings for Use in Low Cost Housing. National Bureau of Standards, Building Materials and Structures Report No. 68, Part 3; 15 cents.

Measurement of Liquefied Petroleum Gases. A group of papers on this subject were included in the Proceedings of the 1940 Conference on Weights and Measures at the National Bureau of Standards. The report of that conference is now available as Bureau of Standards Miscellaneous Publication M167; 55 cents.

Forest Resources of the Douglas-Fir Region. Department of Agriculture, Miscellaneous Publication 389; 50 cents.

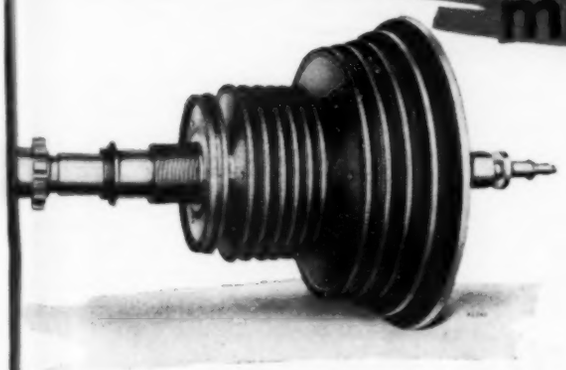
Protection of Log Cabins, Rustic Work and Unseasoned Wood from Injurious Insects, by R. A. St. George. Department of Agriculture, Farmers' Bulletin 1582, Revised January, 1941; 5 cents.

The Vertical Drier for Seed Cotton, by Charles A. Bennett and Francis L.

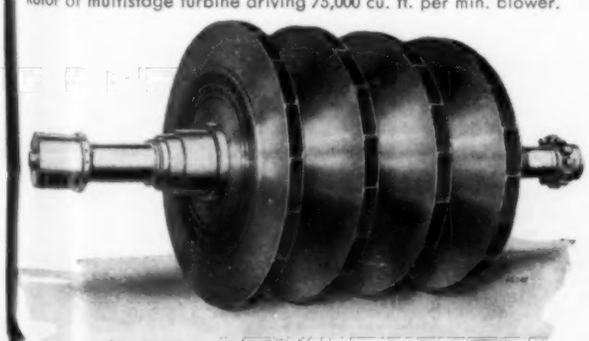


75,000 cu. ft. per min. turbine-driven blast furnace blower supplied to a Western steel mill to handle 60° F. air against 30 lb. gage at 3000 r.p.m. The turbine receives steam at 400 lb. gage and 700° F. and exhausts to a 28 in. vacuum. A second De Laval blower, rated at 85,000 cu. ft. per min., has recently been installed.

Repeat orders show that DE LAVAL BLOWERS AND COMPRESSORS meet requirements



Rotor of multistage turbine driving 75,000 cu. ft. per min. blower.



Rotor of 75,000 cu. ft. per min. blast furnace blower.

THERE are only 118 active blast furnaces in the United States, but many of them use De Laval blowers. The installation shown above was soon followed by a repeat order for an 85,000 c.f.m. unit, which has recently been installed.

Similarly, numerous multiple and repeat installations of De Laval exhausters and compressors for coke oven gas, and of De Laval blowers and boosters for gas manufacturing and distributing systems, have been made.

Why De Laval blowers and compressors have been preferred will be made plain if you will submit your air or gas handling requirements so that we may recommend, and submit prices upon, suitable apparatus.

De Laval blowers and compressors are built in all capacities, for all pressures up to 100 lb., and for motor or turbine drive. Ask for Catalog F.

3815

DE LAVAL STEAM TURBINE CO. · TRENTON, N. J.

Barnstead Water Stills

Purity is a prime factor in the ampules prepared by the modern plant of Schering & Glatz, New York City. For, any impurity in an intravenous solution can be harmful to human lives. So to ensure pure water for their solutions, Schering & Glatz use the distillates of three seventy-five gallons per hour Barnstead Water Stills.

These stills are the most modern type. They are equipped with special Spanish Prison Type Baffles—the surest protection against entrainment. Moreover, they are equipped with hot well and condenser vents that eliminate gaseous impurities. Special demountable condensers and removable evaporator trap doors mounted with steam coils make regular cleanings practical and economical. And constant bleeder devices prevent rapid scale formation within evaporator.

Whenever you want consistently pure water at low cost—in any amounts from ½ to 500 gallons per hour—use Barnstead steam, gas or electrically operated stills.

Send for catalog Contains complete information on all Barnstead Water Stills—from smallest to largest. Shows how they operate; how they are constructed; how they can be installed under all conditions.

Barnstead
STILL & STERILIZER CO. Inc.
4 LANESVILLE TERRACE, FOREST HILLS, BOSTON, MASSACHUSETTS

Gerdes. Department of Agriculture, Miscellaneous Publication 239, Revised March, 1941; 10 cents.

Sources and Available Supplies of Commercial Fertilizers, by C. H. Kunsman. Department of Agriculture, Miscellaneous Publication 400; 5 cents.

Experiments in the Use of Vapor-Spray Equipment, by O. K. Hedden and R. M. Merrill. Department of Agriculture, Circular 598; 5 cents.

Rapid Determination of Soybean Oil Content and of Iodine Number of Soybean Oil, by Lawrence Zeleny and M. H. Neustadt. Department of Agriculture, Technical Bulletin 748; 5 cents.

The Effect of Weather on the Relative Development of Oil and Protein in Cottonseed, by G. S. Meloy. Department of Agriculture, Agricultural Marketing Service, unnumbered document; mimeographed.

The Work of the Division of Insecticide Investigations, 1927-1939. Bureau of Entomology and Plant Quarantine, Division of Insecticide Investigations, E-516; mimeographed.

A List of Commercially Available Detergents, Wetting, Dispersing, and Emulsifying Agents, by H. L. Cupples. Bureau of Entomology and Plant Quarantine, Division of Insecticide Investigations, E-504; mimeographed.

Studies on Foodstuffs Fumigated with Methyl Bromide, by H. C. Dudley and others. Public Health Service, Reprint No. 2215; 10 cents.

Protective Construction. Division of State and Local Cooperation, Office for Emergency Management, Structures Series, Bulletin No. 1; 25 cents.

Priorities and Defense. Monthly the Division of Priorities of O.P.M. will issue a resume of activities, including an up-to-date priorities critical list. The first pamphlet, discussing principles, appeared under date of April, 1941. Those requiring this material should ask not only for that original pamphlet, but also for supplements. For this purpose, address Division of Priorities, Office of Production Management, Washington, D. C.

Extent of Week-end Shut-downs in Selected Defense Industries. Bureau of Labor Statistics, Serial No. R-1270.

Allocation of Tariff Quota on Crude Petroleum and Fuel Oil. Department of State, Executive Agreement Series No. 191; 5 cents.

Statistics of the Communications Industry in the United States, for the Year Ended December 31, 1939. Federal Communications Commission, unnumbered document; 25 cents.

Final Report and Recommendations of the Temporary National Economic Committee. Senate Document No. 35, 77th Congress, 1st Session; $1.00.

Pulpwood Investigation. Hearing before the Committee on Agriculture, House of Representatives, 77th Congress, 1st Session, on H. J. Res. 15.

Motor Carrier Safety Regulations. Revised including orders issued through November 4, 1940. Interstate Commerce Commission, unnumbered document; 20 cents.

Some Basic Information on the Textile Industry. Department of Labor, Wage and Hour Division, Research and Statistics Branch, unnumbered document; mimeographed.

Power and Fuel Data. Summarizing the purchase of electric energy, the installations of power equipment, and the consumption of fuel, during the calendar year 1939, the Census Bureau has issued four preliminary reports in mimeographed form. These are (a) Prime Movers, Motors and Generators: Electric Energy Consumed, Summary for the United States, (b) Prime Movers, Generators, Motors, and Electric Energy Consumed, by Geographic Divisions and States, 1939, 1929, 1927, and 1925, (c) Consumption of Fuel by Manufacturing Establishments for the United States, 1939, 1937, 1929, 1927, and 1923, and by Geographic Divisions and States, 1939, 1937, and 1929, (d) Consumption of Fuel in Manufacturing Establishments for Census Years 1909, 1919, 1929, and 1939, Summary for the United States.

Earthen Floor and Wall Tiles. U. S. Tariff Commission Report No. 141, Second Series; 25 cents.

The House Rat, by James Silver. U. S. Department of the Interior, Wildlife Circular 6; 5 cents.

MANUFACTURERS' LATEST PUBLICATIONS

Publications listed here are available from the manufacturers themselves, without cost unless a price is specifically mentioned. To limit the circulation of their literature to responsible engineers, production men and industrial executives, manufacturers usually specify that requests be made on business letterhead.

Alloys. Revere Copper & Brass, Inc., 230 Park Ave., New York City—24-page booklet giving engineering and other information on this concern's copper and copper alloys for process industries; a similar 16-page booklet on the use of these alloys for power plants and a 44-page booklet on applications in the mechanical industries. Data include chemical and physical properties, corrosion resistance, mechanical properties, manufacturer's forms and other useful information.

Bearings. Split Ballbearing Corp., Lebanon, N. H.—4-page folder on a new self-aligning pivot ball bearing with precision anti-friction operation, including specifications and discussion of applications and load ratings for radial and thrust loads.

Building. Rogear Co., 11 Water St., New York, N. Y.—5 sheets on this company's non-peeling and non-cracking builder's plastic, with directions for inside and outside applications.

Cements. Smooth-On Mfg. Co., Dept. 109, 570 Communipaw Ave., Jersey City, N. J.—40-page booklet on this company's ten types of iron cements for all-purpose repair work, and also data on company's gaskets and clamps. Gives details of uses with numerous drawings on applications.

Chemicals. Tennessee Eastman Corp., Kingsport, Tenn.—Edition 6B—36-page booklet on "Tenite", giving extensive tables and charts of physical properties on this company's cellulose ester plastics made from cellulose acetate and cellulose acetate butyrate. Ten formulas for Tenite thermoplastic molding compositions are given.

Construction. Johns-Manville, 22 E. 40th St., New York—Data Series 585—10-page booklet on this company's "Marinite" combination structural material and insulation for ovens and dryers, with data on properties, applications and construction details, together with numerous cross-sectional drawings.

Control. Adam Hilger Ltd., 98 St. Pancras Way, Camden Road, London, N.W.1, England—SB293—12-page booklet on the electrophoresis apparatus with improved optical system, based upon apparatus of A. Tiselius. Gives brief historical development, details of uses, assemblies and recent literature on applications, accompanied by detailed diagrams.

Control. The Bristol Co., Waterbury, Conn.—Bulletin 570—16-page bulletin on this company's "Strip-Chart" recorders with descriptions, drawings, and technical information. Also Bulletin 567, describing the experience of one user of the company's automatic dye-vat control systems and Bulletin IDS27 on the company's "Dyemaster" for controlling dyeing processes.

Control. Foster Engineering Co., 103 Monroe St., Newark, N. J.—Catalog 70, Bulletin 7—8-page excerpt on company's Y-type pressure reducing regulators for steam, air, liquids and gases, with information on general features, operation, dismantling and reassembling, and drawings and engineering data on specific types.

Control. Moore Products Co., 3629 N. Lawrence St., Philadelphia, Pa.—1-page leaflet for notebook on this company's flow-type liquid level controller, with condensed information on specifications and prices.

Control. The Tempil Corp., 132 W. 22nd St., New York City—2-page folder on this company's thermometric pellets for determining temperatures in welding, heat treating and general metallurgical practice.

Conveyors. Lamson Corp., Syracuse, N. Y.—Form 341—6-page folder illustrating typical installations of this company's conveyors in the food industries; also Form 441—4-page folder on package conveyors for various industries.

Corrosion. The United States Stoneware Co., 60 E. 42nd St., New York—Bulletin 1610—8-page bulletin on this company's "Tygon" corrosion-resistant tank lining material and "Tygon" paint for chemical, metallurgical, textile and process plants, laboratories, etc.

Corrosion. Water Service Laboratories, Inc., 423 W. 126th St., New York—4-page folder on pipe corrosion, especially iron and brass pipe, and how to overcome this by use of concern's automatic proportioning feeding device known as the "Chemistat."

Disbursement. The Todd Co., Rochester, N. Y.—Form 16677—10-page booklet entitled "Disbursement Procedure Simplified," giving fundamental principles of the routine of purchasing supplies and paying for them.

Electrical Equipment. Century Electric Co., St. Louis, Mo.—Units X160, X164, and X167—one-page notebook sheets on two types of this concern's explosion-proof motors, with brief discussion of Underwriters' Lab. inspection and label service.

Electrical Equipment. Allis-Chalmers Mfg. Co., Milwaukee, Wis.—Bulletin B6012A—24-pages on this company's vertical-lift switchgear equipment, with numerous illustrations showing special construction features and advantages, outline drawings, dimensional charts and circuit diagrams.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—GEA-3539—4-page folder on General Electric heating cable for various purposes, with information on applications, specifications, and assemblies. Also GES-2456, 12-page folder with photographs showing typical installations of this company's combination starters.

Electric Equipment. Hevi Duty Electric Co., Milwaukee, Wis.—Bulletin HE441—4 pages on this company's box-type electric furnaces with drawings showing typical construction, detailed description of features, and specification charts.

Electrical Equipment. Ideal Commutator Dresser Co., 1270 Park Ave., Sycamore, Ill.—Form APB141—24-page catalog giving information on this company's electrical equipment such as storage batteries, electric etchers, soldering irons, arc welders, variable speed pulleys, and electric cleaners.

Electrical Equipment. Kato Engineering Co., 530 N. Front St., Mankato, Minn. 2-page sheet of this concern's new model 500 watt, 110-volt, a.c. light and power unit, with information on applications and specifications.

Electrical Equipment. Reeves Pulley Co., Columbus, Ind.—Bulletin on how to speed up production with variable speed control, with 36 examples in all types of industrial plants.

Electrical Equipment. Westinghouse Editorial Service, Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.—Leaflet 39-400—8 pages on this company's insulators for supporting outdoor disconnect switches, bus structures, and other high voltage equipment, with application and construction details, styles, physical dimensions, and electrical data. Also bulletin DD-4063, with 4 pages on a.c. adjustable speed drives between 1 and 15 hp. with design details of motor-generator, d.c.-drive motor, and rheostat with data on ratings, speed ranges.

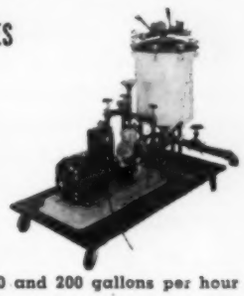
Equipment. A. B. Farquhar Co., Ltd., Hydraulic Press Div., York, Pa.—Bulletin 41H02—16-page catalog on this

LeVal Filters

. . . will lick your toughest filtration problems

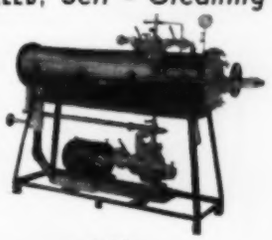
The rigidity, strength and uniform porosity of the LeVal Filter-stone provides greatly increased flow-rates per foot by elimination of non-porous supporting members. High pressures are practical and will not cause deflection of the filtering surface. No paper or cloth is used, therefore no fibers are ever found in the filtrate. The Filter-stone is inert to practically all products.

GREATER FLOW-RATES

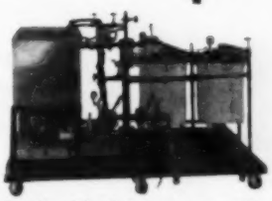


For simple clarifying, LeVal consistently gives flow-rates up to 500% higher than traditional methods. On colloidal and heavy filtrations, flow-rates have been raised from 10 and 15 to 150 and 200 gallons per hour per square ft.

VALVE-CONTROLLED, *Self - Cleaning*



Cleaning is accomplished between runs by simple valve-controlled backwashing (sluicing) — *without opening the filter.*



Installations for flows up to 30,000 gallons per hour

LeVal Filters can be furnished in any capacity —for any filterable liquid—to meet any chemical or physical requirement.

•

When requesting our 26 page booklet, "Filters and Filtering Data No. 63", outline the essentials of your filtration requirements. We usually have supplementary information applicable to specific problems.

LeVal Filter Company

1319 S. MICHIGAN AVE. CHICAGO, ILL.

Eastern Sales Office

50 CHURCH ST. NEW YORK CITY

"It's no use, boys... Can't get through Causplit Cement"

Its unique chemical resistance makes Causplit Cement a success where other cements fail. For Causplit readily handles a wide range of strong acids, alkalies and solvents at temperatures up to 350°F.

And Causplit is quick-setting, tough and durable, easy to apply, resistant to abrasion and to rapid changes in temperature. Proved admirable for corrosion-proof equipment lining in extensive industrial tests, Causplit Cement represents a considerable improvement over Penchlor Acid-Proof Cement and Asplit Cement, which have been successfully used in many industries for over 7 years.

CHEMICAL PLANTS profit by using Causplit because it resists hydrochloric, phosphoric and other strong acids, carbonates, sulfates and other salts, ammonia and various strong alkalies, phenol, toluol, alcohols, acetone and numerous other chemicals. Causplit Cement can be used in equipment handling alkalies and acids alternately—where other cements "wash out."

PAPER AND PULP MILLS find Causplit economical and durable for pulp digesters, bleaching system equipment, acid towers, recovery systems, etc. It withstands abrasion, repeated washings, sudden temperature changes, and chemicals used in the industry—including 50% caustic soda, soda ash, hypochlorites and chlorine, sulfurous acid, sodium sulfite, sodium sulfide, alum and others.

STEEL MILLS can use Causplit Cement for pickling, neutralizing and degreasing tanks and similar equipment because it is unaffected by sulfuric, hydrofluoric and hydrochloric acids, by strong alkalies, salts and solvents. Causplit maintains tight joints and preserves bricks, far outlasting other types of cement construction.

Wire or write today for FREE TEST KIT, including samples, booklet of information and test data showing Causplit's resistance to various acids, alkalies and solvents. Pennsylvania Salt Manufacturing Co., Widener Bldg., Philadelphia, Pa.—New York • Chicago • St. Louis • Pittsburgh • Wyandotte • Tacoma.

PENNSYLVANIA SALT MANUFACTURING COMPANY *Chemicals*

concern's hydraulic presses, accompanied by photographs showing details of construction, for powder, metal forming, straightening, shipyards and other purposes.

Equipment. American Blower Corp., 6000 Russell St., Detroit, Mich.—Bulletin B2529—42-page catalog on this company's fans and other similar equipment, with detailed tables giving capacities, dimensions, and other engineering data, cross-sectional drawings, and application guide section giving useful data on types of ventilating systems, etc.

Equipment. American Machine & Metals, Inc., Debothezat Ventilating Equipment Div., East Moline, Ill.—Form FN441—12-page pamphlet discussing and giving data on sound levels and other related factors governing selection of axial flow fan units.

Equipment. American Pulverizer Co., 1249 Macklind Ave., St. Louis, Mo.—8-page booklet on use of this company's ring crusher, type "S", for crushing coal, accompanied by specification charts, photographs and detailed cross-sectional drawings. Also four-page folder on ring turnings crusher, with discussion of design and construction, photographs and charts of engineering data.

Equipment. Armstrong Machine Works, Three Rivers, Mich.—Bulletin 143—4-page folder on company's air traps with useful information, accompanied by photographs, tables, drawings and charts, on removal of water from compressed air.

Equipment. Bird Machine Co., South Walpole, Mass.—6-page folder describing and illustrating by photograph and cross-sectional drawings this company's centrifugal classifier for continuous classification at any desired particle size.

Equipment. Blaw-Knox Co., Power Piping Div., 1525 Pennsylvania Ave., Pittsburgh, Pa.—Bulletin 1815—10-page bulletin on this company's functional hangers and vibration eliminators for power piping, with drawings, photographs, and tables on applications, assemblies, and specifications.

Equipment. The Carrier Corp., Syracuse, N. Y.—Bulletin 46E10—24-page bulletin giving detailed rating tables for selection of correct requirements for unit heating, also hot water basic ratings, piping and wiring diagrams, and typical layouts for this concern's heating equipment.

Equipment. Durametallic Corp., 2104 Factory St., Kalamazoo, Mich.—4-page sheet on this company's mechanical seal for shafts of centrifugal or rotary pumps and agitators, with general discussion on assemblies and application.

Equipment. Edge Moor Iron Works, Edge Moor, Del.—Circulars 106 and 116—1-page circulars on unfired pressure vessels, with condensation of ASME Code on heat treatment, thickness, pressure and temperature limitations, allowable working stresses, weld tests, etc.

Equipment. The Falk Corp., 3001 West Canal St., Milwaukee, Wis.—Bulletin 8100—20-page bulletin illustrating and describing outstanding features of five types of this concern's "Airflex" couplings, and includes charts on torque deflection curves, cross-sectional drawings, curves for speed factor values, and dimensions and service factor tables.

Equipment. The B. F. Goodrich Co., Mechanical Div., Akron, Ohio—Bulletin 9810—6-pages devoted to the manufacture of rubber printing plates, summarizing processes involved, and deals specifically with materials and methods developed by the company for commercial production of rubber plates.

Equipment. Link-Belt Co., 307 N. Michigan Ave., Chicago, Ill.—Folder 1793—4-pages on this company's new troughing type rubber-tread impact idlers, with drawings, list prices, specification data and general discussion of construction.

Equipment. Manheim Mfg. & Belting Co., Manheim, Pa.—24-page illustrated booklet on this company's adjustable V-belt. Pictures illustrate clearly operating features.

Equipment. New England Tank & Tower Co., Everett, Mass.—94-page booklet giving data on this company's various models of agitators, drives, and other agitating equipment. Data include photographs, drawings, tables and charts, ratios, dimensions, with a special section giving useful engineering data on the general subject of agitation.

Equipment. Productive Equipment Corp., 2926-28 W. Lake St., Chicago, Ill.—Bulletin 441—18-page illustrated booklet on vibrating screens manufactured by this concern, with emphasis on coal processing. Features of the equipment are illustrated by photographs and drawings, together with dimension tables.

Equipment. The Timken Roller Bearing Co., Canton, Ohio—32-page bound booklet showing by photographs the role of this company's bearings in national defense, such as in machinery, ships, guns, tanks, trucks and planes.

Filters. Staynew Filter Corp., Rochester, N. Y.—44-page catalog illustrating and describing this concern's filters for compressed air, gases, liquids, etc., accompanied by illustrations, sectional drawings, specification charts and other detailed engineering data.

Fire-Fighting. Goodall Rubber Co., Inc., 10 S. 36th St., Philadelphia, Pa.—6-page folder on this company's fire-fighting equipment, accompanied by illustrations, tables of dimensions and specifications, and other information on such equipment as hoses of various types, hose couplings, and firemen's clothing.

Hose. Pennsylvania Flexible Metallic Tubing Co., 72nd St. and Powers Lane, Philadelphia, Pa.—Bulletin 55F—8-page folder on this company's flexible all-metal hose for tank cars, including discussion of uses, data on couplings, assemblies, and a weight table.

Pumps. Nash Engineering Co., South Norwalk, Conn.—Bulletin 336—Illustrated booklet on this company's centrifugal Pyrex glass pumps with brief discussion of principles and drawings and engineering data in table and graph form.

Pumps. Worthington Pump Corp., Harrison, N. J.—Bulletin W350-B7—Four-page folder on certain types of this company's centrifugal pumps for chemical and allied industries, with drawings giving details of construction of various types, advantages and tabular dimension data.

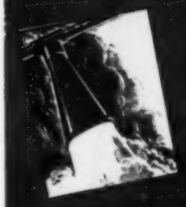
Resins. Plaskon Co., Inc., 2112-24 Sylvan Ave., Toledo, Ohio—12-page, illustrated booklet on this company's resin glue, with photographs of applications, and a general discussion of its features, advantages, uses and nature. Also a folder on hot-setting resin glue with directions for mixing straight and extended glue, preparation of wood, spreading, pressures and temperatures required, curing time, etc.

Safety Appliances. Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh, Pa.—Bulletin No. FA73—2-page folder briefly describing this company's spray kit for burns, using a new therapeutic preparation.

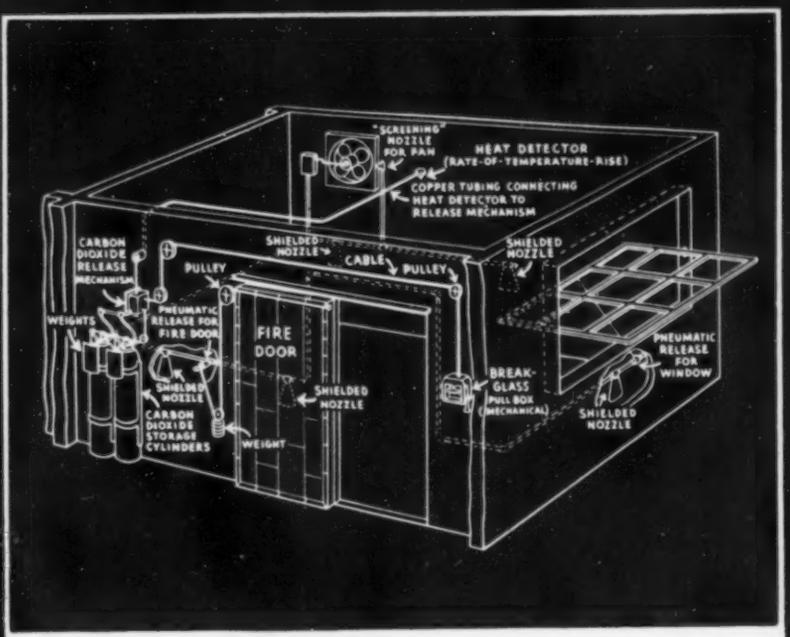
Synthetic Rubber. Hydrocarbon Chemical & Rubber Co., Akron, Ohio—20-page booklet on this company's "Hycar" oil-resistant synthetic rubber, giving detailed and valuable information on properties, adhesion to metals, compounding ingredients and their effects, mixing of "Hycar" compounds, and tables giving physical properties and directions for compounding various mixtures.

Synthetic Rubber. B. F. Goodrich Co., Akron, Ohio—Bulletin describing this company's recently announced synthetic rubber trade-marked "Ameripol", giving detailed description of properties as related to mechanical rubber goods, such as resistance to mineral, animal and vegetable oils and fats, tensile strength, elasticity, tear resistance, and other properties.

Tubing. The Babcock & Wilcox Tube Co., 85 Liberty St., New York—Card No. 1038—A card folder listing seamless tubing wall thickness data in millimeters and inches, and comparing various gages.



BUILT-IN BLIZZARD PROTECTS PROCESS ROOMS FROM FIRE!



HOW IT WORKS —Diagram shows automatic LUX installation for fire detection and carbon dioxide fire extinguishing.

Fire Detection — When fire breaks out, LUX heat detector operates release mechanism. This device is sensitive to rate of temperature rise; it releases weights which operate cutter valves on LUX carbon dioxide cylinders. Break-glass pull-boxes permit manual operation in emergency.

Extinguishing — Carbon dioxide gas is piped to shielded nozzles placed at intervals on walls. Sufficient LUX gas is released to reduce oxygen content of room atmosphere to approximately 14%. Fire cannot live.

Isolation — Room is automatically isolated to prevent fire's spread. Pneumatic LUX releases shut off fans, close windows, doors. Carbon dioxide gas screens the fan-opening.

TRY BUILT-IN PROTECTION!

Automatic control of fire in areas of intense hazard is your plant's surest safeguard against costly blazes.

Built-in LUX fire extinguishing systems kill dangerous blazes with split-second speed. Automatically or manually controlled LUX installations never get panicky, never do the wrong thing. They smother fire fast in a blizzard of LUX carbon dioxide snow-and-gas. Clean, dry—no mess, no damage.

Get LUX fixed-system protection for those hazardous flammable liquid processes. Get the facts on built-in fire fighting. Mail the coupon now and receive free brochure.

Walter Kidde & Company
INCORPORATED
633 West Street, Bloomfield, N. J.
Send me, today, a free copy of "LUX Carbon Dioxide Systems."

NAME_____

COMPANY_____

ADDRESS_____

LOUISVILLE DRYER TURNS $41,650 LOSS INTO PROFIT!

Maybe it sounds paradoxical to say that a company can *lose* money, and at the same time *make a profit*, on its drying operations.

But take the case "blue-printed" at the right. In this particular instance, the manufacturer was showing a profit on his drying operations amounting to $75,800 every 5-month season. He felt that his process couldn't be improved. But he wanted to be *sure*. So he consulted Louisville.

After several pilot plant experiments, Louisville engineers demonstrated conclusively that a specially-designed Louisville dryer—costing 14.6% *more* to operate—would boost profits $41,650, (1) by increasing the product *yield* 11%, and (2) by increasing the product *value* 35%!

PREVIOUS DRYER (5-Month Season)	
Tons raw material	20,000
Tons dried product	4,320
Value @ $20 per ton	$86,400
All drying costs	$10,600
Net annual return	$75,800

LOUISVILLE DRYER (5-Month Season)	
Tons raw material	20,000
Tons dried product	4,800
Value @ $27 per ton	$129,600
All drying costs	$12,150
Net annual return	$117,450
Net Annual Increase from Louisville Dryer	$41,650
(Cost of Louisville Dryer	$45,000)

In other words, every season the manufacturer continued to operate his old dryer, he was *losing* $41,650 in potential profits.

Perhaps a Louisville analysis of your drying process would bring to light profit possibilities equally astounding and equally unsuspected. Why not find out, without cost? Drop us a line today . . . Louisville Drying Machinery Co., *Incorporated*, 451 Baxter Avenue, Louisville, Kentucky.

MOVEMENT OF CHEMICALS INTO CONSUMING OUTLETS CONTINUES TO GAIN IN VOLUME

Chem & Met ECONOMICS and MARKETS

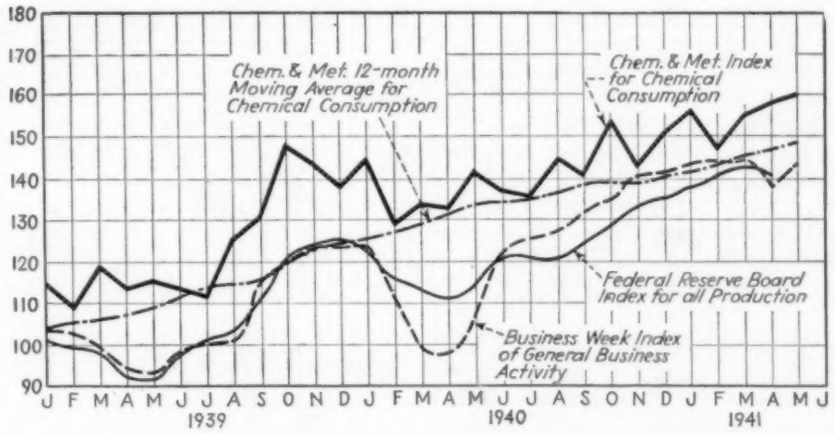
WHILE complete data for operations in May are not yet available, the figures at hand and estimates from trade sources indicate that consumption of chemicals last month reached an all-time high mark. The preliminary weighted index number for consumption of chemicals in May is 160 which compares with a revised number of 158.40 for April and 158.28 for March. For the corresponding months last year the index numbers were 141.35, 132.99, and 133.61 respectively. The upward revision in the index number for April followed the release of production figures which were considerably above what had been expected. Record outputs for any single month were reported for oil refining, glass products, paint and varnish sales, textiles, and rubber goods. It is noted that coal-tar chemicals are not being turned out in direct proportion to operations at byproduct coke plants because the employment of higher temperatures and the reduction in coking time is cutting down the tar content of the coke so that chemical production is being curtailed somewhat because of preference given to steel-mill requirements.

Chem. & Met.'s Weighted Index For Chemical Consumption

	March revised	April
Fertilizer	30.84	27.75
Pulp and paper	22.10	22.00
Petroleum refining	14.37	14.84
Glass	14.90	15.30
Paint and varnish	13.05	16.86
Iron and steel	13.30	12.72
Rayon	12.20	11.90
Textiles	10.50	11.22
Coal products	9.63	8.64
Leather	4.74	4.60
Explosives	5.21	4.90
Rubber	3.86	4.05
Plastics	3.58	3.62
	158.28	158.40

As early plans for the national program were enlarged in later revisions —and the revisions still seem to be tending upward—the idea of business as usual has been discarded and this is well exemplified by the difficulty which some consumers are having in locating sufficient raw materials to take care of their contract commitments. With the declaration of a total emergency, it is inevitable that industry controls will come more and more into operation and the chemical industry can not hope to be an exception. The current scarcity of many chemicals presages a rapidly approaching system of allocation whereby deliveries will be scaled according to the national importance of the finished products into which the chemicals are to be converted. Ammonia unquestionably holds the ranking place at present and it is certain that nitric acid requirements will be paramount. Fertilizer manufacturers, therefore, in the next mixing season will be confronted with the necessity of replacing their normal sources of supply for this chemical. Considerable quantities of plastics are called for under the defense program and the shortage of formaldehyde already has received much attention. Possibly a way may be found to overcome the economic disadvantages of stepping up production of methanol on the part of the wood distillation branch of the industry. Possibly synthetic producers will be asked to make sacrifices in the anti-freeze trade in order to make larger amounts available for formaldehyde. This would mean the loss of a market gained only after a long and costly sales campaign. While chlorine production has been increased in recent years and reports are current regarding further expansions, the fact remains that the supply is small just now and concern is felt lest government requirements will be large enough to cut down the amount left for ordinary use. Even soda ash, for which no scarcity had been expected, has been none too plentiful and some sellers have been hard pressed to fill the demands of greatly enlarged consuming fields. Plans for a sharp increase in production of aluminum will divert worth while amounts of ash into that industry.

With price controls already in effect for some materials and with sulphate of ammonia specifically mentioned in the chemical field, some speculation has arisen regarding further attempts in that direction. A review of the chemical price trend since the outbreak of the war, however, reveals that values, except in the resale market, have moved in a very orderly way and apparently advances have not been commensurate with the higher costs of production and in the majority of cases prices have held at unchanged levels.

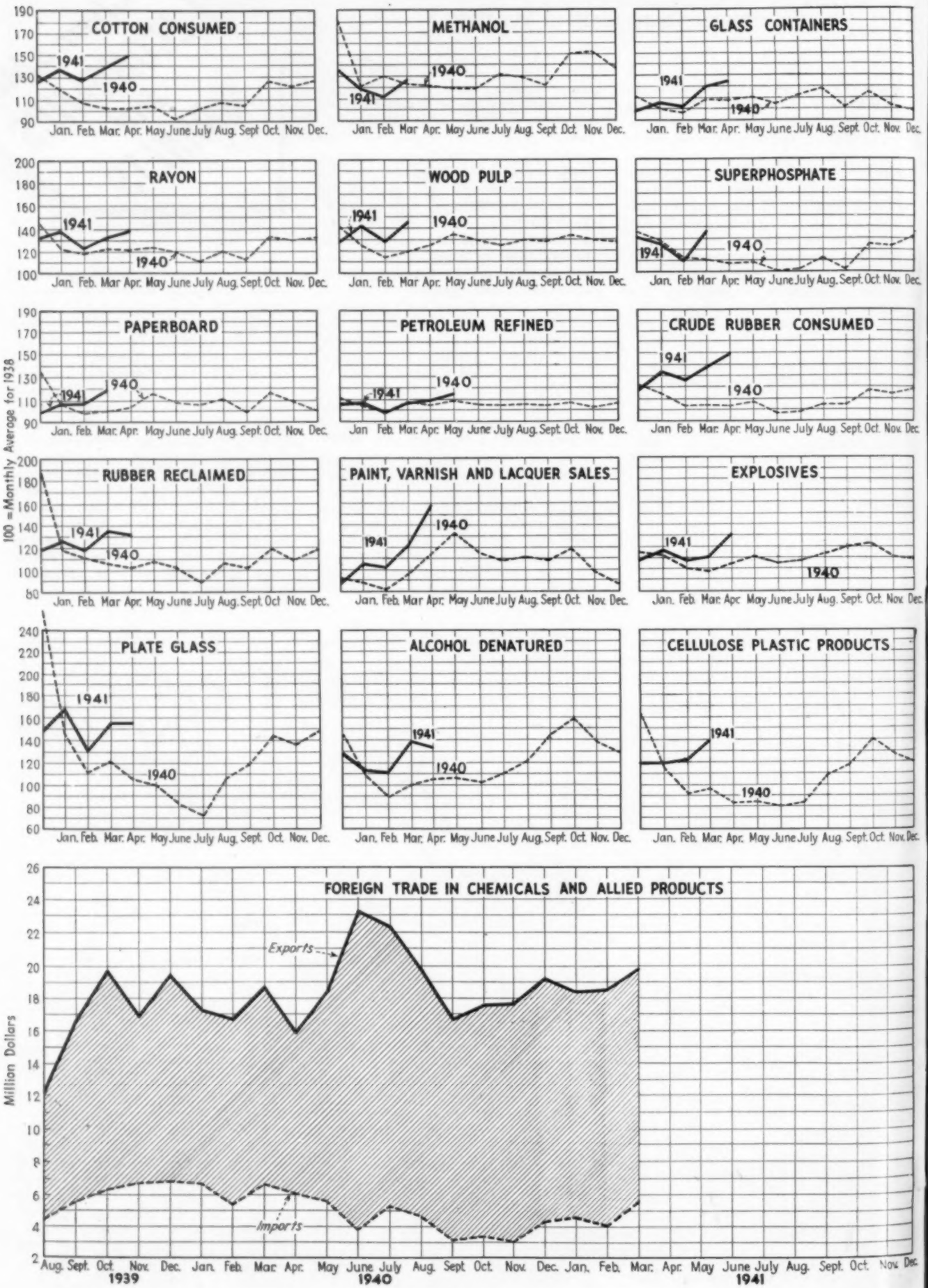

Chem. & Met. 12-month Moving Average for Chemical Consumption
Chem. & Met. Index for Chemical Consumption
Federal Reserve Board Index for all Production
Business Week Index of General Business Activity
180
170
160
150
140
130
120
110
100
90
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J
1939
1940
1941

Production and Consumption Data for Chemical-Consuming Industries

	April 1941	April 1940	January-April 1941	January-April 1940	Per cent of gain for 1941
Production					
Alcohol, ethyl, 1,000 pr. gal.	26,248	20,218	97,697	82,235[1]	18.8
Alcohol denatured, 1,000 wi. gal.	12,654	9,994	47,012	38,377	22.5
Automobiles, no.	462,257	432,746	1,956,579	1,692,677	15.6
Ammonia liquor, 1,000 lb.[2]	5,167	4,327	20,666	18,172	13.7
Ammonium sulphate, tons[2]	57,917	54,570	245,469	224,496	9.3
Benzol, 1,000 gal.[2]	11,649	.....	49,849	.....	....
Toluol, 1,000 gal.[2]	2,181	.....	9,032	.....	....
Naphthalene, 1,000 lb.	7,272	.....	26,293	.....	....
Byproduct coke, 1,000 tons	4,474	3,984	18,909	16,833	12.2
Glass containers, 1,000 gr.	5,325	4,584	19,335	17,576	10.0
Plate glass, 1,000 sq. ft.	18,344	12,367	71,624	57,101	25.4
Window glass, 1,000 boxes	1,400	1,023	5,775	4,642	24.4
Rubber reclaimed, tons	21,574	16,668	83,500	71,091	17.4
Consumption					
Cotton, bales	920,142	623,098	3,411,221	2,643,856	29.0
Silk, bales	23,538	21,740	105,902	95,416	11.0
Paint and varnish, $1,000	51,964	37,656	160,444	124,453	29.0
Rubber, crude, tons	71,374	50,103	263,436	205,105	28.4
Rubber, reclaimed, tons	20,427	16,298	76,005	63,669	19.4

[1] March total revised to 25,194,435 pr. gal. [2] Byproduct coke production.

Production and Consumption Trends



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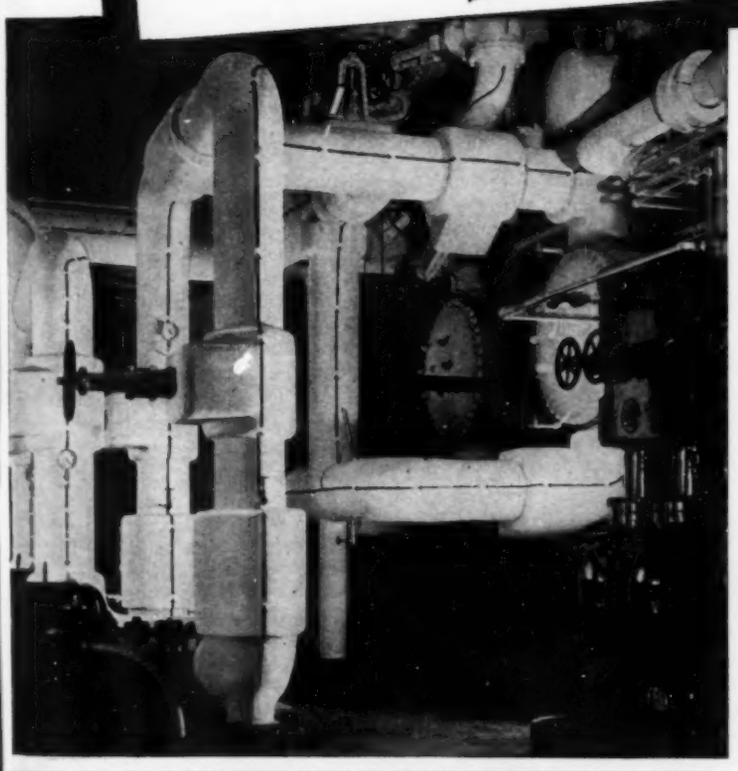

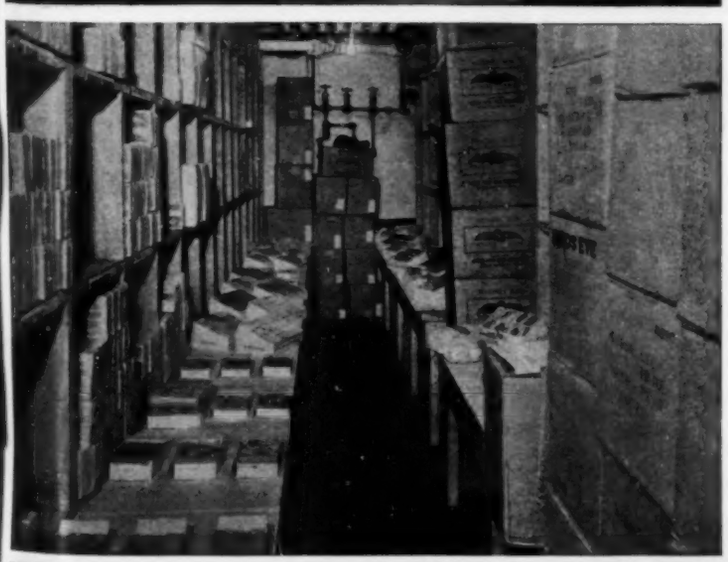

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(Bottom)—LARGE QUANTITIES *of quick-frozen foods are held safely at zero, or colder, in this corkboard-insulated room of E. B. Gale, Inc., Binghamton, New York. Architect: A. G. Sennewald. Engineer: G. H. Dyke.*

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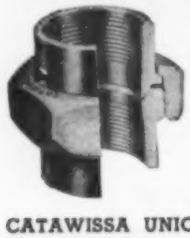

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WRITE FOR BULLETIN NO. 88

THE CENTRAL FORGING CO.
CATAWISSA, PENNA.

FACTS and FIGURES

of

AMERICAN CHEMICAL INDUSTRY

★ Reprinted from *Chem. & Met.'s* February 1941 issue, wherein the editors presented a 40-page public accounting of the economic and technical status of the nation's most important industry. It is addressed to everybody because we are all stockholders, customers and/or employees in this billion dollar business that in 1940 topped all production records.

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OUTPUTS OF CHEMICALS ARE PASSING TO CONTRACT HOLDERS WITH SPOT STOCKS LIMITED

WHILE most chemical plants are described as working at capacity, the greater part of production is passing against existing contracts with very little surplus for spot trading. In some cases contract deliveries are behind schedule and adjustments in producing plants have cut down outputs of some chemicals in order to give preference to others which are more important in the defense program. To summarize the present situation, it may be stated that production of many chemicals is not large enough to take care of combined national and industrial needs. Naturally this has created a strong price situation for the chemicals which are scarce and whereas the greater part of all production is being distributed with very little price advance, a small-lot trading has been going on for some time with no stable prices in effect and with relatively high prices being obtained for whatever offerings are available.

Values for oils and fats continued to rise throughout the last month although some of the increases were not maintained. A temporary halt to the advancing price movement resulted when announcement was made that a previously determined rise in freight rates for moving copra and coconut oil had been rescinded. Freights for bringing linseed from the Argentine also were reported to have dropped but crushers do not place much confidence in the quoted charter rates. As cottonseed oil, because of its tonnage importance, exerts the greatest price influence, the course of the growing cotton crop is followed with interest. A large seed supply appears to be the only possibility of bearish significance on the market for oils and fats.

Export inquiry for chemicals is active with small stocks cutting down the actual volume of business placed. In some quarters, the outlook for export trade is regarded as less promising due to the lack of shipping space which is expected to become more or less under government supervision with export shipments coming under some kind of allocation arrangement. Canada has been taking steps to extend its production of some of the chemicals formerly imported from this country. For instance a plant in Nova Scotia is reported to have started production of toluol, xylol, and light oils. Last year, the United States shipped 13,908,000 lb. of toluol to Canada. Another report from Canada states that a subsidiary of Canadian Industries will build a plant at Cornwall, Ont., for carbon bisulphide manufacture.

OPACS wants the price of ammonium sulphate "frozen" at a maximum of $28 a ton on contract, $29 a ton at port, with a $1 premium on spot sales. Administrator Leon Henderson has written all producers and distributors asking them to continue formal price quotations indefinitely and to inform him "well in advance" of any action to increase the price. The action is a request, but failure to comply to OPACS' satisfaction will bring a formal order fixing a price ceiling.

In making his request, Henderson conceded a recent tightness in the supply of ammonium sulphate but argued that inasmuch as the coke industry has been operating at capacity for several months there appears no reason why prices should rise now. Thus is put into practice the OPACS philosophy that mere tightness in supply is not justification for a price increase. In OPACS philosophy only legitimate cost increases justify higher prices.

Priorities in the chemical field are looming on the horizon on the OPM Priorities Division's work-sheet. Just what chemical commodities are likely to be put under rationing first can't be cited; even OPM doesn't know yet. All officials are willing to say is that shortages are looming ahead in a number of items.

Frankly guessing, on the basis of the best possible information, leads to the suggestion that ammonia might be one chemical up for allocation action; a tight situation is feared between the time the new powder plants extend operations and work on the government ammonia plants is completed. Acetone has been placed on the Army-Navy critical list, often a prelude to more drastic priorities action.

The Priorities Division admittedly does not take action to ration scarce materials until the situation becomes critical. Voluntary cooperation by producers and consumers is much preferred and always tried before allocation of supply is applied.

A threatened shortage in certain natural resins essential to the manu-

CHEM. & MET.

Weighted Index of

CHEMICAL PRICES

Base=100 for 1937

This month	100.49
Last month	100.14
June, 1940	98.57
June, 1939	97.21

Basic conditions have changed but little during the month. Most outputs are moving against contracts and spot supplies are limited. The trend of values is upward and some revisions will be made on later shipments with the probability that prices will strengthen as the year advances.

facture of protective coatings has been averted through action of the Division of Purchases. Ordinarily about 20,000 tons of such natural resins as kauri, batu, elemi and damar are required annually. These resins come from the Orient; lack of shipping recently caused some 5,000 tons to accumulate at Singapore, Batavia and Macassar awaiting shipment. Best efforts of the importers to obtain shipping space proved fruitless. This situation was examined by one of the industry subcommittees set up under the direction of the Division of Purchases. The problem was taken up with the Maritime Commission and with the Netherlands Legation in Washington. As a result, shipping space has been made available for transport of the needed materials.

The Department of Commerce reports that the State Council of Ceylon recently approved the expenditure of a sum not exceeding 225,000 rupees ($67,000) for the erection and equipment of a "pilot" plant capable of manufacturing up to 100 tons annually of acetic acid and other byproducts. Acetic acid is used in Ceylon for coagulating rubber.

Normally Ceylon imports acetic acid from continental Europe but recently has had to look to the United States for its requirements.

United States exports of acetic acid to Ceylon in 1940 amounted to 178,000 pounds, valued at $18,700.

Imports of coal-tar dyes into China were valued at 5,925,500 gold units (one gold unit approximated US$0.677 at Shanghai and Central and South China ports) in 1940, 6 percent below the corresponding figure for the year 1939. Germany continued the leading supplier with 56 percent of the trade, a decline of 11 percent from 1939; Japan, ranking second, dropped from 21 to 15 percent; and the share of the United States rose from 6 to 15 percent. Receipts from Switzerland and Italy also recorded increases.

Plastics from carbolic acid and from cellulose are now being produced in Shanghai by the Sheng Te Weaving Factory. Molding powder is manufactured from imported phenol, formaldehyde, hexamine, and casein.

CHEM. & MET.

Weighted Index of Prices for

OILS & FATS

Base = 100 for 1937

This month	**112.00**
Last month	108.76
June, 1940	73.36
June, 1939	71.09

Although some of the oils have declined from peak prices reached earlier in the period, the average level is higher than it was a month ago. The undertone remains firm with the price trend likely to influenced by reports from the cotton fields as cottonseed oil prices will affect the general market.

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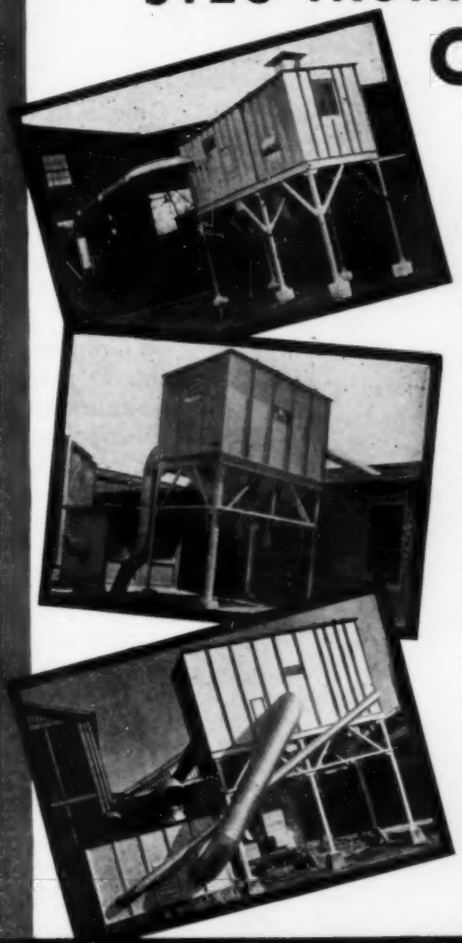

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CONTAINERS FOR GASES, LIQUIDS AND SOLIDS

Chem & Met Current PRICES

INDUSTRIAL CHEMICALS

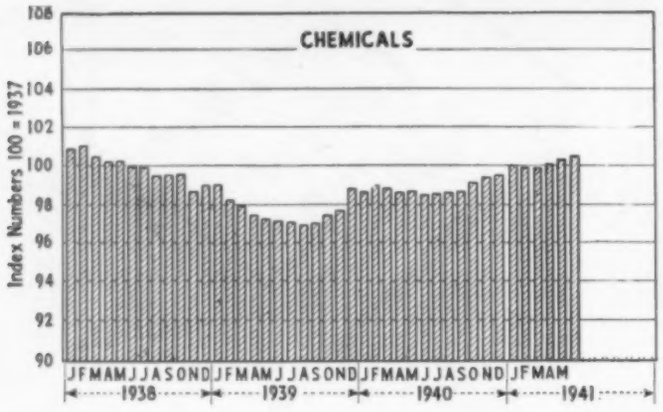
	Current Price	Last Month	Last Year
Acetone, drums, lb	$0.07½–$0.08	$0.07½–$0.08	$0.07½–$0.07½
Acid, acetic, 28%, bbl., cwt	2.23 – 2.48	2.23 – 2.48	2.23 – 2.48
Glacial 99%, drums	8.43 – 8.68	8.43 – 8.68	8.43 – 8.68
U. S. P. Reagent	10.25 –10.50	10.25 –10.50	10.25 –10.50
Boric, bbl., ton	106.00–111.00	106.00–111.00	106.00–111.00
Citric, kegs, lb	.20 – .23	.20 – .23	.20 – .23
Formic, cbys., lb	.10½– .11	.10½– .11	.10½– .11
Gallic, tech., bbl., lb	.90 – 1.00	.90 – 1.00	.90 – 1.00
Hydrofluoric 30% drums, lb	.08 – .08½	.08 – .08½	.08 – .08½
Lactic, 44%, tech., light, bbl., lb	.06½– .06¾	.06½– .06¾	.06½– .06¾
Muriatic, 18°, tanks, cwt	1.05 –	1.05 –	1.05 –
Nitric, 36°, carboys, lb	.05 – .05½	.05 – .05½	.05 – .05½
Oleum, tanks, wks., ton	18.50 –20.00	18.50 –	18.50 –20.00
Oxalic, crystals, bbl., lb	.10¾– .12	.10¾– .12	.10¾– .12
Phosphoric, tech, c'bys., lb	.07½– .08½	.07½– .08½	.07½– .08½
Sulphuric, 60°, tanks, ton	13.00 –	13.00 –	13.00 –
Sulphuric, 66°, tanks, ton	16.50 –	16.50 –	16.50 –
Tannic, tech, bbl., lb	.54 – .56	.54 – .56	.54 – .56
Tartaric, powd., bbl., lb	.63 –	.63 –	.37½–
Tungstic, bbl, lb	nom	nom	nom
Alcohol, amyl	–	–	–
From Pentane, tanks, lb	.111–	.111–	.101–
Alcohol. Butyl, tanks, lb	.09 –	.09 –	.09 –
Alcohol, Ethyl, 190 p'f., bbl., gal	6.04 –	6.04 –	4.54 –
Denatured, 190 proof	–	–	–
No. 1 special, dr., gal. wks	.33 –	.33 –	.29½–
Alum, ammonia, lump, bbl., lb	.03½– .04	.03½– .04	.03½– .04
Potash, lump, bbl., lb	.03½– .04	.03½– .04	.03½– .04
Aluminum sulphate, com. bags, cwt	1.15 – 1.40	1.15 – 1.40	1.15 – 1.40
Iron free, bg., cwt	1.60 – 1.70	1.60 – 1.70	1.60 – 1.70
Aqua ammonia, 26°, drums, lb	.02½– .03	.02½– .03	.02½– .03
tanks, lb	.02 – .02¼	.02 – .02¼	.02 – .02¼
Ammonia, anhydrous, cyl., lb	.16 –	.16 –	.16 –
tanks, lb	.04½–	.04½–	.04½–
Ammonium carbonate, powd. tech., casks, lb	.09 – .12	.09 – .12	.09 – .12
Sulphate, wks., cwt	1.45 –	1.45 –	1.40 –
Amylacetate tech., from pentane, tanks, lb	.10½–	.10½–	.10½–
Antimony Oxide, bbl., lb	.12 –	.12 –	.12 –
Arsenic, white, powd., bbl., lb	.03½– .04	.03½– .04	.03 – .03½
Red, powd., kegs, lb	nom	nom	.17– .18
Barium carbonate, bbl., ton	52.50 –57.50	52.50 –57.50	52.50 –57.50
Chloride, bbl., ton	79.00 –81.00	79.00 –81.00	79.00 –81.00
Nitrate, casks, lb	.09½– .10	.08½– .10	.07 – .08
Blanc fixe, dry, bbl., lb	.03½– .04	.03½– .04	.03½– .04
Bleaching powder, f.o.b., wks., drums, cwt	2.00 – 2.10	2.00 – 2.10	2.00 – 2.10
Borax, gran., bags, ton	43.00 –	43.00 –	43.00 –51.00
Bromine, cs., lb	.30 – .32	.30 – .32	.30 – .32
Calcium acetate, bags	1.90 –	1.90 –	1.90 –
Arsenate, dr., lb	.06½– .06¾	.06½– .06¾	.06¾– .07
Carbide drums, lb	.04¾– .05	.04¾– .05	.04¾– .05
Chloride, fused, dr., del., ton	19.00 –24.50	19.00 –24.50	21.50 –24.50
flake, dr., del., ton	20.50 –25.00	20.50 –25.00	23.00 –25.00
Phosphate, bbl., lb	.07½– .08	.07½– .08	.07½– .08
Carbon bisulphide, drums, lb	.05 – .06	.05 – .06	.05 – .06
Tetrachloride drums, lb	.04¾– .05½	.04¾– .05½	.04¾– .05½
Chlorine, liquid, tanks, wks., lb	1.75 –	1.75 –	1.75 –
Cylinders	.05½– .06	.05½– .06	.05½– .06
Cobalt oxide, cans, lb	1.84 – 1.87	1.84 – 1.87	1.84 – 1.87
Copperas, bgs., f.o.b. wks, ton	18.00 –19.00	18.00 –19.00	18.00 –19.00
Copper carbonate, bbl., lb	.10 – .16½	.10 – .16½	.10 – .16
Sulphate, bbl., cwt	4.75 – 5.00	4.75 – 5.00	4.60 – 4.85
Cream of tartar, bbl., lb	.52 –	.52 –	.30½–
Diethylene glycol, dr., lb	.22 – .23	.22 – .23	.22 – .23
Epsom salt, dom.,tech., bbl., cwt	1.80 – 2.00	1.80 – 2.00	1.80 – 2.00
Ethyl acetate, drums, lb	.07½–	.07½–	.07 –
Formaldehyde, 40%, bbl., lb	.05½– .06	.05½– .06½	.05½– .06½
Furfural, tanks, lb	.09 –	.09 –	.09 –
Fusel oil, drums, lb	.16 – .17	.16 – .17	.16 – .17
Glaubers, salt, bags, cwt	.95 – 1.00	.95 – 1.00	.95 – 1.00
Glycerine, c.p., drums, extra, lb	.14½–	.12½–	.12½–
Lead:			
White, basic carbonate, dry casks, lb	.07½–	.07½–	.07 –
White, basic sulphate, sck., lb	.07½–	.07½–	.06½–
Red, dry, sck., lb	.0835	.0835	.07½–
Lead acetate, white crys, bbl., lb	.12 – .13	.11 – .12	.11 – .12
Lead arsenate, powd., bag, lb	.09½– .11	.09½– .11	.08½– .11
Lime, chem., bulk, ton	8.50 –	8.50 –	8.50 –
Litharge, pwd., csk., lb	.0735	.0735	.06½–
Lithophone, bags, lb	.0385 .04	.0385 .04	.036– .04
Magnesium carb., tech., bags, lb	.06½– .06¾	.06½– .06¾	.06½– .06¾
Methanol, 95%, tanks, gal	.29 –	.29 –	.29 –
97%, tanks, gal	.30 –	.30 –	.30 –
Synthetic, tanks, gal	.30 –	.30 –	.30 –
Nickel salt, double, bbl., lb	.13¼– .13½	.13¼– .13½	.13 – .13¼
Orange mineral, csk., lb	.11½–	.11½–	.10½–
Phosphorus, red, cases, lb	.40 – .42	.40 – .42	.40 – .42
Yellow, cases, lb	.18 – .25	.18 – .25	.18 – .25
Potassium bichromate, casks, lb	.09½– .10	.08½– .09	.08¼– .09
Carbonate, 80–85%, calc. csk., lb	.06½– .07	.06½– .07	.06½– .07
Chlorate, powd., lb	.10 – .12	.10 – .12	.10 – .12
Hydroxide(c'stic potash) dr., lb	.07 – .07½	.07 – .07½	.07 – .07½
Muriate, 80% bags, unit	.53½–	.53½–	.53½–
Nitrate, bbl., lb	.05½– .06	.05½– .06	.05½– .06
Permanganate, drums, lb	.19½– .20	.19½– .20	.18½– .19
Prussiate, yellow, casks, lb	.16 – .17	.15 – .16	.15 – .16
Sal ammoniac, white, casks, lb	.0515 .06	.0515 .06	.05½– .06
Salsoda, bbl., cwt	1.00 – 1.05	1.00 – 1.05	1.00 – 1.05
Salt cake, bulk, ton	17.00 –	17.00 –	23.00 –
Soda ash, light, 58%, bags, contract, cwt	1.05 –	1.05 –	1.05 –
Dense, bags, cwt	1.10 –	1.10 –	1.10 –
Soda, caustic, 76%, solid, drums, cwt	2.30 – 3.00	2.30 – 3.00	2.30 – 3.00
Acetate, works, bbl., lb	.04 – .05	.04 – .05	.04 – .05
Bicarbonate, bbl., cwt	1.70 – 2.00	1.70 – 2.00	1.70 – 2.00
Bichromate, casks, lb	.07½– .08	.06¼– .07	.06¼– .07
Bisulphate, bulk, ton	16.00 –17.00	16.00 –17.00	15.00 –16.00
Bisulphite, bbl., lb	.03 – .04	.03 – .04	.03½– .04
Chlorate, kegs, lb	.06½– .06¾	.06½– .06¾	.06¼– .06¾
Cyanide, cases, dom., lb	.14 – .15	.14 – .15	.14 – .15
Fluoride, bbl., lb	.07 – .08	.07 – .08	.07½– .08
Hyposulphite, bbl., cwt	2.40 – 2.50	2.40 – 2.50	2.40 – 2.50
Metasilicate, bbl., cwt	2.35 – 2.40	2.35 – 2.40	2.20 – 3.20
Nitrate, bulk, cwt	1.45 –	1.45 –	1.45 –
Nitrite, casks, lb	.06½– .07	.06½– .07	.06½– .07
Phosphate, tribasic, bags, lb	2.35 –	2.35 –	2.25 –
Prussiate, yel. drums, lb	.10½– .11	.10½– .11	.10½– .11
Silicate (40° dr.) wks., cwt	.80 – .85	.80 – .85	.80 – .85
Sulphide, fused, 60–62%, dr. lb	.02½– .03½	.02½– .03	.02½– .03
Sulphite, crys, bbl., lb	.02½– .02¾	.02½– .02¾	.02½– .02¾
Sulphur, crude at mine, bulk, ton	16.00 –	16.00 –	16.00 –
Chloride, dr., lb	.03 – .04	.03 – .04	.03 – .04
Dioxide, cyl., lb	.07 – .08	.07 – .08	.07 – .07½
Flour, bag, cwt	1.60 – 3.00	1.60 – 3.00	1.60 – 3.00
Tin Oxide, bbl., lb	mon	.54 –	.51 –
Crystals, bbl., lb	.39 –	.39 –	.41½–
Zinc, chloride, gran, bbl., lb	.05 – .06	.05 – .06	.05 – .06
Carbonate, bbl., lb	.14 – .15	.14 – .15	.14 – .15
Cyanide, dr., lb	.33 – .35	.33 – .35	.33 – .35
Dust, bbl., lb	.09½–	.09½–	.07½–
Zinc oxide, lead free, bag, lb	.06½–	.06½–	.06½–
5% lead sulphate, bags, lb	.06½–	.06½–	.06½–
Sulphate, bbl., cwt	3.15 – 3.25	3.15 – 3.25	2.75 – 3.00

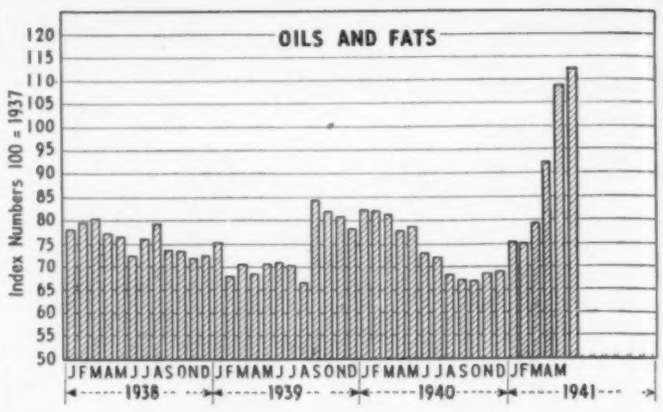
OILS AND FATS

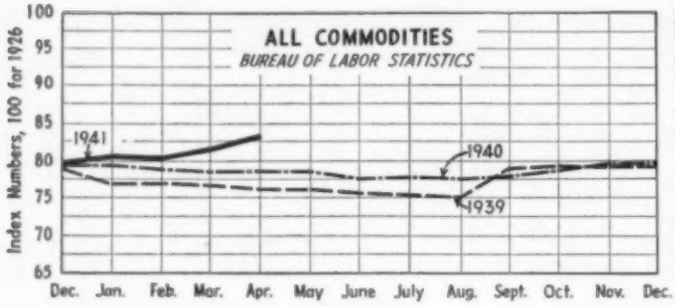
	Current Price	Last Month	Last Year
Castor oil, 3 bbl., lb	$0.11–$0.11½	$0.11 –$0.11½	$0.11½–$0.12
Chinawood oil, bbl., lb	.32 –	.31 –	.24 –
Coconut oil, Ceylon, tank, N. Y., lb	.07 –	.07 –	.03 –
Corn oil crude, tanks (f.o.b. mill), lb	.10¾–	.09½–	.05½–
Cottonseed oil, crude (f.o.b. mill), tanks, lb	.09½–	.09½–	.05½–
Linseed oil, raw car lots, bbl., lb	.107–	.109–	.10 –
Palm, casks, lb	.05½–	.05½–	.04½–
Peanut oil, crude, tanks (mill), lb	.09½–	.09½–	.05½–
Rapeseed oil, refined, bbl., lb	.12 –	.12 –	.12 –
Soya bean, tank, lb	.09½–	.08½–	.04½–
Sulphur (olive foots), bbl., lb	.14½–	.14½–	.08½–
Cod, Newfoundland, bbl., gal	nom	nom	nom
Menhaden, light pressed, bbl., lb	.10 –	.10 –	.073–
Crude, tanks (f.o.b. factory), gal	.50 –	.50 –	.33 –
Grease, yellow, loose, lb	.07½–	.06½–	.03½–
Oleo stearine, lb	.09½–	.09½–	.05½–
Oleo oil, No. 1	.10½–	.10½–	.06½–
Red oil, distilled, d.p. bbl., lb	.10½–	.10½–	.08 –
Tallow extra, loose, lb	.07½–	.07½–	.04½–

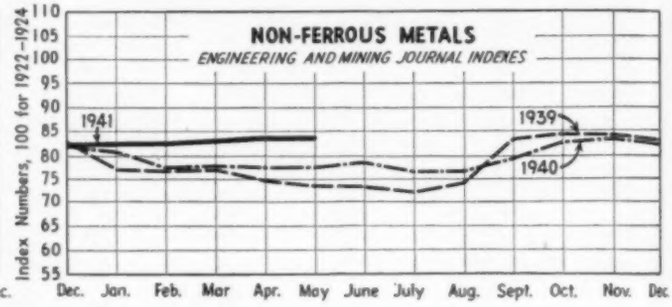
The accompanying prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to June 11

Chem. & Met.'s Weighted Price Indexes









Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-napthol, crude bbl., lb.	$0.52 -$0.55	$0.52- $0.55	$0.52 -$0.55
Alpha-naphthylamine, bbl., lb.	.32 - .34	.32 - .34	.32 - .34
Aniline oil, drums, extra, lb.	.15 - .16	.15 - .16	.15 - .16
Aniline, salts, bbl., lb.	.22 - .24	.22 - .24	.22 - .24
Bensaldehyde, U.S.P., dr., lb.	.85 - .95	.85 - .95	.85 - .95
Bensidine base, bbl., lb.	.70 - .75	.70 - .75	.70 - .75
Bensoic acid, U.S.P., kgs., lb.	.54 - .56	.54 - .56	.54 - .56
Bensyl chloride, tech., dr., lb.	.23 - .25	.23 - .25	.23 - .25
Benzol, 90%, tanks, works, gal.	.14 -.....	.14 - .14	.16 - .18
Beta-napthol, tech., drums, lb.	.23 - .24	.23 - .24	.23 - .24
Cresol, U.S.P., dr., lb.	.09½- .10	.09½- .10	.09½- .10
Cresylic acid, dr., wks., gal.	.58 - .60	.58 - .60	.58 - .60
Diethylaniline, dr., lb.	.40 - .45	.40 - .45	.40 - .45
Dinitrophenol, bbl., lb.	.23 - .25	.23 - .25	.23 - .25
Dinitrotoluol, bbl., lb.	.15½- .16	.15½- .16	.15½- .16
Dip oil, 15%, dr., gal.	.23 - .25	.23 - .25	.23 - .25
Diphenylamine, dr. fob wks., lb.	.70 -.....	.70.....	.....
H-acid, bbl., lb.	.45 - .50	.45 - .55	.50 - .55
Naphthalene, flake, bbl., lb.	.07 - .07½	.07 - .07½	.06½- .07
Nitrobensene, dr., lb.	.08 - .09	.08 - .09	.08 - .09
Para-nitraniline, bbl., lb.	.47 - .49	.47 - .49	.47 - .49
Phenol, U.S.P., drums, lb.	.12 -.....	.12 -.....	.13 -.....
Picric acid, bbl., lb.	.35 - .40	.35 - .40	.35 - .40
Pyridine, dr., gal.	1.70 - 1.80	1.70 - 1.80	1.70 - 1.80
Resorcinol, tech., kegs, lb.	.75 - .80	.75 - .80	.75 - .80
Salicylic acid, tech., bbl., lb.	.33 - .40	.33 - .40	.33 - .40
Solvent naptha, w.w., tanks, gal.	.27 -.....	.27 -.....	.27 -.....
Tolidine, bbl., lb.	.86 - .88	.86 - .88	.86 - .88
Toluol, drums, works, gal.	.30 -.....	.30 -.....	.30 -.....
Xylol, com, tanks, gal.	.26 -.....	.26 -.....	.27 -.....

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	$22.00-$25.00	$22.00-$25.00	$22.00-$25.00
Casein, tech, bbl., lb.	.21 - .22	.16 - .17	.13 - .14
China clay, dom., f.o.b. mine, ton.	8.00 -20.00	8.00 -20.00	8.00 -20.00
Dry colors			
Carbon gas, black (wks.), lb.	.03½- .30	.03½- .30	.028- .30
Prussian blue, bbl., lb.	.36 - .37	.36 - .37	.36 - .37
Ultramarine blue, bbl., lb.	.11 - .26	.11 - .26	.10 - .26
Chrome green, bbl., lb.	.21½- .30	.21½- .30	.21 - .27
Carmine, red, tins, lb.	4.60 - 4.75	4.60 - 4.75	4.85 - 5.00
Para toner, lb.	.75 - .80	.75 - .80	.75 - .80
Vermilion, English, bbl., lb.	3.20 - 3.25	3.12 - 3.20	nom
Chrome yellow, C.P., bbl., lb.	.14½- .15½	.14½- .15½	.14½- .15½
Feldspar, No. 1 (f.o.b. N.C.), ton.	6.50 - 7.50	6.50 - 7.50	6.50 - 7.50
Graphite, Ceylon, lump, bbl., lb.	.08 - .10	.06 - .06½	.06 - .06½
Gum copal Congo, bags, lb.	.08 - .30	.08 - .30	.06 - .30
Manila, bags, lb.	.09 - .15	.09 - .14	.09 - .14
Damar, Batavia, cases, lb.	.10 - .22	.10 - .20	.08 - .24
Kauri, cases, lb.	.18 - .60	.18 - .60	.18½- .60
Kieselguhr (f.o.b. mines), ton.	7.00 -40.00	7.00 -40.00	7.00 -40.00
Magnesite, calc, ton	65.00 -.....	65.00 -.....	65.00 -.....
Pumice stone, lump. bbl., lb.	.05 - .07	.05 - .08	.05 - .07
Imported, casks, lb.	nom	nom	.03 - .04
Rosin, H., 100 lb.	2.48 -.....	2.52 -.....	..... -.....
Turpentine, gal.	.47½-.....	.47½-.....	.32 -.....
Shellac, orange, fine, bags, lb.	.34 -.....	.34 -.....	.25 -.....
Bleached, bonedry, bags, lb.	.31½-.....	.31½-.....	.26 -.....
T. N. Bags, lb.	.24½-.....	.24 -.....	.13½-.....
Soapstone (f.o.b. Vt.), bags, ton.	10.00 -12.00	10.00 -12.00	10.00 -12.00
Talc. 200 mesh (f.o.b. Vt.), ton.	8.00 - 8.50	8.00 - 8.50	8.00 - 8.50
200 mesh (f.o.b. Ga.), ton.	6.00 - 8.00	6.00 - 8.00	7.50 -11.00

Industrial Notes

CHAIN BELT CO., Milwaukee, has appointed D. A. Kalton and A. W. Thomas as assistants to the sales manager of the construction equipment division.

MORRIS MACHINE WORKS, Baldwinsville, N. Y., is now represented in the Detroit district by L. J. Lynch with headquarters in the Kales Bldg.

PUMICE CORP. OF AMERICA, has been formed to take over from the Barnsdall Tripoli Co., its pumice mill at Grants, N. M. The new corporation is owned by the McAleer Mfg. Co., Detroit, and Whittaker, Clark & Daniels, New York.

THE GLIDDEN CO., Cleveland, has added Edmund V. Tyne to its pigments, metal and soya divisions of which P. E. Sprague is in charge of sales.

W. H. BIXBY, INC., Des Moines, announces that R. C. Adams has joined the organization in the capacity of sales engineer.

PHILADELPHIA ELECTRIC CO., Philadelphia, has placed a contract with the Koppers Co., Pittsburgh, to build 21 coke ovens at its byproduct coke plant in Chester, Pa. Work to start at once and be completed in in April 1942.

PAISLEY PRODUCTS, INC., Chicago, has purchased the equipment, formulas, and processes of the Western Adhesives Co.

ALLIS-CHALMERS MFG. CO., Milwaukee, has moved its office in Toledo to the Toledo Trust Bldg. W. R. Mengel is in charge of the office.

JESSOP STEEL CO., Washington, Pa., has transferred Howard M. Dawson from the Cleveland office to Detroit. D. J. Hanna is manager of the new Detroit warehouse and office.

PITTSBURGH PIPING & EQUIPMENT CO., Pittsburgh, has elected officers as follows: Charles R. Rall, president and treasurer; Louis K. Hamilton, vice-president; Joseph G. Gardner, secretary; Karl F. Tiegel, director of purchases and estimates; and G. Sinding Larsen, chief engineer.

DELTA-STAR ELECTRIC CO., Chicago, has made the following organization changes: R. E. Anderson becomes vice-president; C. S. Beattie, manager of engineering; W. O. Hampton, chief design engineer; S. C. Killian, development and research engineer; and W. H. Boyce, manager of industrial sales.

BUILDERS-PROVIDENCE, INC., Providence, R. I., is now the corporate name of the former Builders Iron Foundry.

THE LOGAN ENGINEERING CO., Chicago, is now represented in Iowa by J. A. McCoy with headquarters at 1436 41st Place, Des Moines.

AMPCO METAL CO., Milwaukee, announces that Ray J. Thompson, its eastern district manager, is now located at 57 White St., West Hartford, Conn.

Ideas for your Notebook..

FROM CARBIDE AND CARBON CHEMICALS CORPORATION

Prevailing Low Price Promotes the Increasing Use of Ethanolamines

BEST known to industry because of the emulsifying power of their soaps, the ethanolamines are now available at prices which permit their wider use as chemical intermediates and hygroscopic agents. More than ever, they become interesting for the production of amides, substituted amines, and other compounds that assist in penetrating, impregnating, or scouring operations. Also, they can now be employed as economical softening agents and humectants, especially for applications where their mild alkalinity and pronounced hygroscopicity are desirable. For further information, send for literature and data sheets on these low-cost ethanolamines.

Efficient acid gas absorption obtained with Ethanolamines — Removal of acid gases from gas mixtures is effectively and economically accomplished with the ethanolamines. The concentration of CO_2, the removal of H_2S from hydrocarbon gases, the purification of gas-engine fuel, and the production of inert atmospheres are some of the many uses now being practiced.

Flexible paper coatings are produced by Ethanolamine emulsions — Used in casein and shellac dispersions or in paraffin and carnauba wax emulsions, the ethanolamines not only produce a uniform coating for paper but also give the resulting films excellent adhesion, stability, and flexibility. The ethanolamines are likewise of value with such products as latex, gums, starches, and synthetic resins in impregnating and sizing paper.

Excellent acetate rayon dyestuffs now made from Phenylethanolamines — By coupling the phenylethanolamines with various diazo compounds, useful acetate rayon dyes are obtained. These azo dyes are readily applied to the goods and reduce crocking to a minimum.

Insecticide spray oils are emulsified with Ethanolamines—Ethanolamine soaps effectively emulsify spray oils (especially those containing lead arsenate) which are applied to fruit and other vegetation in pest control. Due to their unusually low alkalinity, foliage damage is considerably less than when caustic alkalies are used.

Triethanolamine improves solubility of dry-cleaning soaps—Triethanolamine soaps exhibit marked detergency and increased solubility in dry-cleaning solvents. They pass through filters readily and brighten dull colors. Greater value per pound of soap is obtained because only a minimum of free acid is required to obtain complete solubility.

For information concerning the uses of the ethanolamines, address:

CARBIDE AND CARBON CHEMICALS CORPORATION

Unit of Union Carbide and Carbon Corporation • 30 East 42nd Street, New York, N. Y.

UCC

PRODUCERS OF SYNTHETIC ORGANIC CHEMICALS

Chem & Met New CONSTRUCTION

	Current Projects		Cumulative 1941	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	$1,045,000	$303,000	$1,275,000	$3,976,000
Middle Atlantic	40,000	1,190,000	13,090,000	17,097,000
South	1,000,000	40,000	12,593,000	18,035,000
Middle West	1,000,000	3,135,000	3,685,000	6,045,000
West of Mississippi	2,150,000	860,000	10,255,000	11,189,000
Far West	80,000	211,000	1,202,000	16,135,000
Canada	.....	.....	610,000	170,000
Total	$5,315,000	$5,739,000	$42,710,000	$72,667,000

PROPOSED WORK

Calif., San Francisco—Pacific Vegetable Oil Corp., 62 Townsend St., plans to expand its steel tank storage facilities, etc. Estimated cost $40,000.

Calif., San Francisco—Poetsch & Peterson, 3100 Army St., contemplate the construction of a tannery at South San Francisco. Estimated cost will exceed $40,000.

Conn., Danbury—Plaskon Co., Danbury, will soon award the contract for a 3 story factory here. Lockwood Greene Engineers, Inc., Rockefeller Plaza, New York, N. Y., Engrs. Estimated cost $1,000,000.

Conn., Fairfield—Bridgeport Moulded Products Co., 300 Myrtle Ave., Bridgeport, plans to construct a 1 story, 100x122 ft. addition to its factory on Kings Highway Ext. and Meadow St. Estimated cost $45,000.

Ind., East Chicago—Linde Air Products Division of Union Carbide & Carbon Corp., 30 East 42nd St., New York, N. Y., is having preliminary plans prepared by S. R. Donnellon, Engr., 205 East 42nd St., New York City, for a gas plant here. Estimated cost $1,000,000.

N. J., Bound Brook—Bakelite Corp., 247 Park Ave., New York, N. Y., will soon award the contract for a 1 story, 190x240 ft. addition to its warehouse and 2 story addition to its machine shop. Francisco & Jacobus, 511 Fifth Ave., New York, Archts.

S. C., Georgetown—Southern Kraft Corp., 220 East 42nd St., New York, N. Y., plans to construct additions to its plant here. Estimated cost $1,000,000.

Tex., Beeville—Phillips Petroleum Co., Beeville, and Tulsa, Okla., plans to construct a recycling plant in the West Tuleta fields near Beeville. Estimated cost $250,000.

Tex., Eastland—War Dept., Wash., D. C., plans to construct two plants in the vicinity of Eastland Lake for the manufacture of powder and war time explosives.

Tex., Freer—Champlin & Bass, Inc., Magnolia Bldg., Dallas, plans to construct a 50,000,000 cu. ft. recycling plant in the Sejita Fields near here. Estimated cost $1,100,000.

Tex., Laredo—United Gas Co., Lardeo, is having plans prepared by Wirtz-Calhoun & Willauer, 500 Stuart Ave., Houston, for a 1 story storage and shop building. Estimated cost $50,000.

Tex., Longview—Lone Starr Gas Co., 1915 Wood St., Dallas, and c/o C. B. Lacy, Longview, plans to construct a recycling plant here. Estimated cost $300,000.

Tex., Old Ocean—Harrison & Abercrombie, Gulf Bldg., Houston, plans to improve and expand existing recycling plant at Old Ocean in the vicinity of Angleton. Estimated cost $100,000.

Tex., Shepherd—Harrison & Abercrombie, Gulf Bldg., Houston, Tex., and Blessing, Tex., plans to construct a recycling plant in the vicinity of Shepherd. Estimated cost $250,000.

CONTRACTS AWARDED

Calif., Berkeley—California Ink Co., Inc., 545 Sansome St., San Francisco, has awarded the contract for a 1 story flushing department unit at its plant to Austin Co., 1001 Ray Bldg., Oakland, at $42,800.

Calif., Berkeley—Tri-City Paint Co., 2003 University Ave., has awarded the contract for a factory to W. C. Johnson, 5900 Burlingame Ave., Berkeley. Estimated cost $40,000.

Calif., Los Angeles—Western Waxed Paper Co., Div. of Crown-Zellerbach Corp., 910 East 61st St., has awarded the contract for a 150x175 ft. warehouse to Engineer's Ltd., 605 West Olympic Blvd. Estimated cost $40,000.

Calif., Oakland—Pacific Oxygen Co., 2205 Magnolia St., has awarded the contract for the construction of a factory to C. C. Rosenberry, 1401 Mountain Blvd., Oakland, at $42,500.

Calif., Petaluma—Shell Oil Co., Shell Bldg., San Francisco, has awarded the contract for a distribution plant, warehouse, bulk storage structures, etc., to F. C. Stolte, 1405 San Antonio Ave., Alameda. Estimated cost $45,000.

Conn., Stamford—Atlas Powder Co., 296 Ludlow St., has awarded the contract for plant additions including a 1 story, 70x95 ft. building, warehouse, platform and second story 70x150 ft. addition to Samworth-Hughes Co., 177 Van Houten St., Paterson, N. J., at $53,000.

Ga., Cedartown—National Oil Products Co., Cedartown, has awarded the contract for a 96x130 ft. factory to Wright & Lopez, Cedartown. Estimated cost $40,000.

Ky., Louisville—B. F. Goodrich Co., Akron, O., has awarded the contract for a plant for the manufacture of synthetic rubber to Batson Cook Co., West Point, Ga. Defense Plant Corp. will finance plant. Estimated cost $1,000,000.

Mass., West Boylston—Shell Oil Co., Inc., 50 West 50th St., New York, N. Y., will build a storage terminal and sales office, garage and warehouse here. Work will be done by separate contracts. Estimated cost $200,000.

Mass., Worcester—Wyman-Gordon Co., 105 Madison St., has awarded the contract for a 2 story, 45x125 ft. laboratory to J. B. Lowell, Inc., 44 Portland St. Estimated cost $50,000.

Mich., Wyandotte—Pennsylvania Salt Mfg. Co., Wyandotte, has awarded the contract for a 1 and 2 story, 122x126 ft. and 1 story, 30x65 ft. factory buildings to Barton-Malow Co., 1900 East Jefferson Ave., Detroit. Estimated cost $75,000.

Mo., St. Louis—Ajax Corrugated Paper Co., 3000 North Second St., has awarded the contract for a 1 story, 99x340 ft. factory to Murch-Jarvis Co., Inc., Cotton Belt Bldg., St. Louis. Estimated cost $60,000.

N. J., Bayonne—Standard Oil Co. of New Jersey, 26 Bway., New York, N. Y., will improve its plant at Constable Hook including healing drums, loading racks and four storage tanks. Work will be done by own forces. Estimated cost $250,000.

N. J., Newark—Pittsburgh Plate Glass Co., 4 Chester Ave., has awarded the contract for a 1 and 2 story, 60x70 ft. plant to F. J. Briscoe Co., Inc., 287 South 12th St. Estimated cost $60,000.

N. J., Summit—Ciba Pharmaceutical Products, Inc., Lafayette Park, has awarded the contract for a 2 story, 60x125 ft. laboratory at Lafayette Park to Walter Kidde, Inc., 140 Cedar St., New York City. Estimated cost $90,000.

N. Y., Bolivar—Allegany Refiners, Inc., H. W. Wachli, Gen. Mgr., will improve and construct additions to its oil refinery. Work will be done by owner. Estimated cost $60,000.

N. Y., Corning—Corning Glass Works, Walnut St., have awarded the contract for a 2 story, 100x350 ft. plant to H. K. Ferguson Co., Hanna Bldg., Cleveland, O. Estimated cost $200,000.

N. Y., Niagara Falls—Carborundum Co., Buffalo, has awarded the contract for factory buildings to Wright & Kremers, Inc., Main St. Estimated cost will exceed $40,000.

N. Y., Tonawanda—Linde Air Products Co., 30 East 42nd St., New York, N. Y., has awarded the contract for a plant here to John W. Cowper Co., 775 Main St., Tonawanda. Estimated cost $250,000.

O., Akron—Goodyear Tire & Rubber Co. has awarded the contract for a plant for the manufacture of synthetic rubber to Indiana Engineering & Construction Co., Fort Wayne, Ind. Defense Plant Corp., will finance plant. Estimated cost including equipment $1,250,000.

O., Cleveland—Cleveland Graphite Bronze Co., 880 East 72nd St., has awarded the contract for a 1 story, 343x683 ft. main factory building, 1 story, 163x252 ft. castings building, office building, etc., to A. M. Higley Co., 2036 East 22nd St. Estimated cost $3,000,000.

O., Cleveland—Harshaw Chemical Co., 1945 East 97th St., has awarded the contract for a 1 story, 100x120 ft. factory to DeHamel Construction Co., 850 Euclid Ave., Cleveland. Estimated cost $60,000.

Pa., Creighton—Pittsburgh Plate Glass Co., Grant Bldg., Pittsburgh, will construct a 4 story, 20x228 ft. addition to its plant here. Work will be done by separate contracts. Estimated cost $100,000.

Pa., Philadelphia—Bisbee Linseed Oil Co., Delaware Ave., has awarded the contract for a 160x160 ft. factory to Arnold Bowen, 1110 Edgewood Rd., Brookline, Pa. Estimated cost $100,000.

Pa., Washington—Tygart Valley Glass Co., O. C. Noble, Pres., Wylie Ave., will construct a 1 story warehouse. Work will be done by separate contracts. Estimated cost $40,000.

Tex., Deer Park—Shell Oil Co., Shell Bldg., Houston, has awarded the contract for a new toluol plant here to C. F. Braun Co., Alhambra, Calif. Estimated cost $500,000.

Tex., Rio Grande City—Continental Oil Co., Oil and Gas Bldg., Houston, will construct a pressure maintenance plant to have a capacity of 1,750,000 cu. ft. per day. Work will be done by day labor and sub contracts. Estimated cost $300,000.